Essays on the Indian economy

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Essays on the Indian economy: competitive pressure, productivity and performance

Amarendra Sahoo

This dissertation is dedicated to my father

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time
(T.S. Eliot)

Essays on the Indian economy: competitive pressure, productivity and performance

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit van Tilburg, op gezag van de rector magnificus, prof. dr. F.A. van der Duyn Schouten, in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de aula van de Universiteit op vrijdag 22 februari 2008 om 14.15 uur door

Amarendra Saoo

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PROMOTOR: prof. dr. Jeffrey James
COPROMOTOR: dr. M.H. ten Raa

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Contents

Chapter 1

Introduction

1.1 Background

How would the competitive pressure affect productivity and welfare distribution of the Indian economy? Are the observed wage differentials between skilled and unskilled labour different from their productivity differentials over a decade of pursuit for the competitive market in the Indian economy and what is the performance of the economy over the periods? What would be the contribution of education process to the wage-productivity inequality and what would be the optimal returns to education? Do all the formal activities perform better than the informal activities in India and what would be the gain to the economy if factors were productively allocated?

A rise in productivity holds the key to progress and prosperity in any economy. The crisis from the late Eighties along with the Gulf war in the beginning of 1990s pushed the Indian economy to an unprecedented crisis resulting in acute internal as well external imbalances. With a view to improving the efficiency, productivity and global competitiveness, both macro and microeconomic reforms were introduced in industrial, trade and financial policy regime. Since 1991, India has undertaken a drastic economic reform program, with the significant objectives of fine-tuning internal as well as external imbalances and enhancing global competitiveness. Though economic growth in the initial years of the reforms were only 0.5 per cent points higher than the pre-reform period, it went up to 7 per cent in the last few years,

showing a lagged effect of radical reforms[1]. Some growth accounting studies have shown that this growth is associated with rise in total factor productivity (TFP), in the service sector rather than in the manufacturing sector (Sivasubramonian, 2004; Bosworth et al. 2006; Mehra, (2007). Goldar and Mitra (2002), and Goldar and Kumari (2003) argued that the decline in factor productivity in manufacturing in the post-liberalization period is due to the lack of capacity utilization. They also found a positive relationship between trade openness and TFP for Indian industries. Undoubtedly productivity carves a special niche in the present era of Indian economic development.

Recent experience has shown that protection of less-than-productive employment is a failing policy in the face of growing technological progress (Reddy, 2005). It is believed that the existence of a wage premium in India could be due to a lack of perfect labour mobility across sectors. Recently India has done an excellent job in the supply of skilled labour having been ranked 12th according to The World Competitiveness Year book (2000). However, it has been ranked only 45th for the degree of labour market flexibility in the Global Competitiveness Report (1998). Despite its effort to be globally competitive, Indian economy is certainly lagging behind in the race. In terms of foreign direct investment it has averaged only around 0.5 percent during last decade as compared to 5-5.5 percents in China and Brazil. Similarly, India's share in the world merchandise exports has been between 0.5 and 0.7 percents in last two decades, while that of China has been almost 4 percent. A competitive environment is a prerequisite condition for gaining higher productivity and efficiency. The main desired role of economic liberalization is to enhance the efficient utilization of inputs with relaxing constraints input use and technology choices and gains from international trade by bringing global competitive pressure to the economy. Increase in productivity and efficiency gain also puts forth the issues of wage disparity and welfare distribution.

[1] This has been termed as the J curve of liberalizations and productivity change according to Virmani (2005).

Given the heterogeneous nature of the Indian economy and with the changing importance of different sectors, existence of formal-informal duality and skilled-unskilled disparity, this study of productivity and efficiency is not confined to the sectoral level. The dissertation proposes a macro productivity-efficiency analysis while taking care of the inter-linkages in the economy. This is extended to address a few important issues of the Indian economy, viz. competitive environment, income distribution, poverty, skilled-unskilled wage disparity and performance of formal-informal sectors. An attempt has been made in this dissertation to capture these above-mentioned issues with the help of three independent essays, which constitute the three core chapters of the thesis.

1.2 Research Issues

Productivity plays an important role in accelerating the pace of growth. For all practical purposes it is sufficient to understand productivity in terms of the rate of efficiency with which resources are converted into the production of goods and services what satisfies human wants of the society. The combination of inputs are subject to changes as a result of changing relative prices, changing technical knowledge or changing output if returns to scale are not constant. The change in total factor productivity (TFP) is interpreted as: (i) the rate of change of an index of outputs divided by an index of inputs (Jorgenson and Griliches, 1967) or (ii) a rate of shift in a production function (Tinbergen, 1942; Solow, 1957). Productivity is a measurement of efficiency of production.

The productivity analysis used in the dissertation deviates from the standard neo-classical growth accounting by combining it with frontier analysis to accommodate inefficiencies (see ten Raa and Mohnen, 2002)[2]. An analysis of inefficiencies is critical towards an understanding of developing

[2] See ten Raa and Shestalova, (2006) for a survey on various measurement issues of total factor productivity.

economies. Farrell (1957) argued that sub-optimality in productivity achievement is because the firm has chosen inappropriate combination of factors and inefficient use of the combination, i.e. allocative and technical inefficiencies respectively. Literature on frontier analysis assigns TFP to technical change and efficiency change catching-up with the frontier (see Färe, Grosskopf, Norris and Zhang, 1994), while neo-classical efficiency is the reallocation of resources. The basic model in this dissertation considers the three sources of productivity-growth: efficient utilization of available resources (Debreu, 1951), technical progress by the Solow residual (Solow, 1957) and gain from terms of trade by re-orientation of trade. The analytical tool in the dissertation is based on a general equilibrium-activity analysis. Following Negishi (1960) welfare maximization subject to input, trade and domestic consumption constraints describes the competitive equilibrium. The economy at the sub-optimal allocation is pushed towards its best production possibility frontier, the potential of the economy. The gap between the potential (optimal allocation) and the actual one is a measure for the inefficiency in the economy. Competitive input prices reflect factor productivity. Variants of this model are used in three different studies of this thesis. Incorporation of input-output framework captures the inter-sectoral linkages. The social accounting matrix (SAM), which plays an important role in establishing inter-linkages in the economy, provides basic data set for our model. This matrix is a combination of national accounts statistics, input-output analysis and household income distribution for a particular period[3].

Chapter 2 discusses the gains in efficiency and productivity due to competitive pressure, and its distributional effects. Efficient utilization of the available resources, technical progress and free trade constitute the sources of growth. Welfare would increase under competition, but the income distribution would become more skewed. The best result of the productivity-efficiency gain would be once the country that is marked by inefficiencies is pushed to its

[3] See Pyatt, et al. (1977), Pyatt and Round (1979) and Pradhan, et al. (2006) for details on social accounting matrix.

frontier by maximizing total welfare of the economy. The resultant competitive factor as well as commodity prices would force the households to re-adjust their consumption and income, which may lead to losers and winners among the households. The economy is classified into 21 production sectors. There are four rural and five urban occupational household groups.

A poverty analysis is incorporated into the study. The FGT poverty measure is used (Foster, Greer and Thorbecke, 1984), which is suitable to estimate group-wise poverty. The measurement of poverty requires an estimation of the income distribution within the each group. For within group distribution a lognormal frequency distribution is used. The optimum solutions of our general equilibrium model yields set of new relative prices and mean income of household groups, which are used to calculate the changes in poverty line and mean income from the observed level. The inequality is measured by the Gini coefficient. The reference period of our analysis is 1994, the beginning of drastic liberalization era. The study establishes a positive effect of competitive market on productivity gain and income inequality and the opposite on poverty.

Chapter 3 evaluates wage inequality and efficiency of the economy in the face of a competitive pressure. The analysis covers two time periods: 1994, the beginning of liberalization era and end period is almost a decade later, 2002. The post-liberalization period is marked by a rise in returns to higher education due to increase productivity of services and skilled-based industries. There has also been an increased supply of labour force in the middle level of education due to significant performance of basic education. This has led to almost stagnant change in skill premium between 1994 and 2002. Competition would lead the economy to gain in the productivity and to re-orientation of market-based supply and demand of skills. A perfectly competitive environment is simulated for both the periods by pushing the economy to its production frontier. Competitive wages would reflect labour productivity. Ratio of competitive wages of skilled to unskilled labour defines the

productivity inequality. Observed wage inequality is evaluated by comparing it with the productivity inequality.

Education process is incorporated into the productivity analysis as a factor influencing human capital formation (skilled labour supply). A simple two-period dynamic model is used in our frontier-productivity analysis to take care of skill transformation and capital formation over time period. Optimum education would lead to higher entry of labour force to education in the first period and leading to increased supply of skilled labour in the second period. This would influence both present and future relative wages. The education process also facilitates us in deriving returns to education. Competitive market indicates the potential of the economy. Performance of the economy compared to its potential marks the efficiency of the economy. We notice that efficiency of the economy is lower than its potential in both the periods; however, it is much lower in the second period.

The study shows that productivity inequality is significantly higher than the wage inequality in the initial period and is lower in the second period. This is due to the decline in competitive skilled wage and increase in unskilled wage relative to the observed in the second period. Productivity inequality (relative productivity) is sensitive to the degree of elasticity of substitution between two types of labour. The productivity inequality between skilled and unskilled labour is seen to be significantly higher than the wage inequality in the initial period due to increased productivity of skilled labour. However, productivity inequality declines in the second period and it even remains below the observed wage inequality. Productivity inequality also declines with a higher elasticity of substitution in the first period because of rising productivity of unskilled labour.

A decomposition exercise is conducted that captures the importance of each factor, e.g. trade efficiency, human capital formation, physical capital formation and static allocative efficiency (efficiency due to allocation of resources in a period), in the aggregate effect of competitive pressure on the change in wage differentials and performance of the economy vis-à-vis the

observed. The decomposition approach is based on an extended Fisher Index (Ang et al, 2004), which is a geometric average of all the combinations of the Laspeyres and Paasche indices. Trade efficiency plays significant role in raising the productivity inequality. However, an increase in the supply of skilled labour due to human capital formation leads to lowering of productivity inequality in the second period. Lack of trade efficiency is also a crucial factor for the lower efficiency of the Indian economy in both the periods. Lack of trade efficiency, in particular, is found to be mainly responsible for the lower efficiency of the economy. However, larger accumulations of human and physical capitals, not being matched by enough demand in the second period are also crucial in reducing the efficiency. Competitive pressure would remove the existing inefficiencies of the economy by the expansion of final demand.

Chapter 4 attempts to evaluate the relative performance of formal and informal sectors in India, which produce the same commodity with different technologies. In order to capture the differentials we evaluate their productivity levels. Traditionally, formal sectors and informal sectors are, though, supposed to cater to same consumer demand, yet play different role in wage formation, employment generation and hence income distribution because of their nature of production. Informal sector is marked by less or no tax payment, less capital endowment, lower technology, lower wage and producing wage goods. Generally productivity is analysed using observed input and output prices. Observed prices are generally not efficient as they are marked by inefficiencies and distortions of several kinds. The key theoretical contribution of this paper is that recognizing the intersectoral linkages in the economy, the competitive general equilibrium prices are computed; these signal the productivities. These prices are used to compute the productivity levels of the formal and informal activities.

Competitive prices result in complete specialization in production of a homogeneous commodity by a relatively more productive sector. Considering the fact that substitutability and mobility assumption of factors of production plays significant role in deciding relative performance at competitive prices,

some relevant assumptions are made in this direction. It's not possible for informal capital to perform as formal capital; while other way around is possible. On the other hand, formal labour (regular) can enter into the informal labour market (casual) both in formal and informal sectors when they lose their job, but the opposite is not possible. This asymmetry generates a nonnegative competitive premium for both formal capital and regular labour. The analysis shows that formal activities are more productive than the informal ones except for the informal service sector, which is as productive as its formal counterpart.

Chapter 2

Competitive pressure on the Indian households: a general equilibrium approach*

2.1 Introduction

After an economic crisis, India resorted to a major program of reform in 1991, to improve efficiency, productivity and global competitiveness. Macro- and microeconomic reforms were introduced in industrial, trade and financial policies (Bhagwati and Srinivasan, 1993). The Indian economy seemed to be responsive to the reform measures undertaken during 1991-96; it featured globalisation and liberalization. GDP grew more than 6.5 percent per annum during this period. However, reform commentators believe that India's agenda is still unfinished. Bajpai and Sachs (1997), Fischer (2002) and others advocate a greater momentum of reform, with more openness in trade, deregulation of industries, and agricultural and labour market reforms. It is expected that the further reform will spur the economy to reallocate its resources efficiently and thus raise productivity. Once the economy operates on its frontier, competitive factor rewards would change the households' income and consumption and thus the welfare distribution. We analyse the consequences with the aid of a general equilibrium model built around a Social Accounting Matrix (SAM).

In the tradition of Kaldor (1956) and Kuznets (1955), Papanek and Kyn (1986) and Fields (1991), Cogneau and Guenard (2002), discuss the issue if growth creates or absorbs inequality. Economic growth creates employment opportunities and thus changes the income distribution. Indian industries were inefficient and hampered by pervasive government control. Although India has an impressive record of growth since the late 1980s, it still faces massive

* This chapter is based to a great extent on ten Raa and Sahoo (2007).

poverty and inequality. Many studies, viz. Kawani and Subbarao (1990), Jain and Tendulkar (1990), Datt and Ravallion (1992), and Ravallion and Datt (1996), emphasized the influence of growth on poverty in India.

The Indian economy is still well within its production possibility frontier. The inefficiency can be measured by the degree by which the net output vector could be extended given the resource and technology constraints (ten Raa, 1995). Despite many sceptical views on free trade versus growth (Rodriguez and Rodrik, 1999; Rodrik, 1999), there has been strong evidence that free trade enhances growth (Sachs and Warner, 1995; Edwards, 1992). Trade and development economists have exposited that in the absence of market failure and distortions, trade stimulates growth and improves welfare (Bhagwati, 1994; Srinivasan and Bhagawati, 1999). Competitive pressure can push the economy towards its production possibility set and trade can augment this set. Thus, the economy becomes not only productively efficient (on its production possibility frontier), but also allocatively efficient (on the utility possibility frontier) (Srinivasan and Bhagwati, 1999).

Few studies have analysed the sources of productivity growth in a general equilibrium framework. Ten Raa and Mohnen (2002) found a shift of the source of productivity growth from technical change to the terms of trade effect for the Canadian economy. Shestalova (2002) used a new technological measure to analyse the total factor productivity (TFP) performance of the three large trading economies endogenizing not only the domestic prices, but also the terms of trade. Ten Raa and Pan (2005) have analysed the personal income distribution using an inter-provincial model in the Chinese economy. We derive the sources of income for different household groups (or ownership of factor endowments), and their expenditure patterns from the Indian SAM. As we confine our analysis to the income distribution of households at the national level, we adjust the weights attached to the household in the welfare function, comparing the computed propensities to consume to the observed ones, rather than the trade surpluses in the cited studies. In the equilibrium, the ratio of new propensity to consume to the observed one should be same for each household

group. This is because, if the household's propensity to consume at the optimum exceeds benchmark propensity to consume more than the other household, then the general equilibrium welfare maximization requires that former household should be assigned with higher consumption share than the later. This is compatible with the welfare maximization program that shows that a competitive equilibrium can be represented through a welfare optimum with non-zero welfare weights (consumption weights) such that all consumers satisfy their budget constraints (Negishi 1960).

The rest of the paper is divided into five sections. The theoretical model is presented in the Section 2. Section 3 analyses the basic data set. Section 4 briefly describes the analysis of poverty and inequality measures in our framework. Results and implications of the model are discussed in the Section 5, while Section 6 concludes the paper.

2.2 The Methodology

The benchmark data set describes the Indian economy for the fiscal year 1994-95. The model distinguishes 21 production sectors. Four rural and five urban household groups are classified by their main source of income. Households have welfare function of the Leontief type, that is, the observed consumption bundles are presumed to be preferred by the household. We make the small country assumption, under which producers take the world prices of the commodities[4]. The pattern of trade will be endogenous, but the level of imports is controlled by the observed deficit on the balance of payment. Capital, labour, agricultural land and the deficit are considered to constitute the "endowments" of the economy. The model assumes that the competitive

[4] India's share in world merchandise exports and imports in value term have been only 1.1 percent and 1.4 percent respectively; its shares in world exports and imports of commercial services have been only 1.5 percent and 1.8 percent respectively (WTO, 2005).

market allows labour to move freely among the sectors. However, we assume that capital and land are sector-specific.[5]

Each household group has a consumption demand vector, $f_h d_h D$, where D is the scalar of total consumption demand, f_h is the vector of consumption shares of the commodities and d_h represents the consumption weight attached to the household group. The model maximizes total final private consumption subject to the commodity, factor and trade deficit constraints, while preserving the compositions of the vectors of private consumption of the household groups. The other components of final demand, government consumption and investment, are fixed in the model. The shadow prices are used to derive the competitive income of each household group. The implied competitive propensities to consume are matched to the observed ones, by adjusting the consumption weights given to the households. The allocations of activity and shadow prices that are finally obtained constitute the general equilibrium (Negishi, 1960).

The SAM provides a consistent data framework for economy-wide models with detailed accounts for industries, categories of working persons, institutional sub-sectors, and various socio-economic household groups. The rows in the SAM state the receipts (or income) of the different accounts and the columns the expenditures (or costs). Table 2.1 gives a bird's eye view of the SAM we have used for our analysis. The input-output table is in the first cell. The first column also shows how factor endowments owned by the different household groups contribute to the production process (the value added cell). The second column shows the factor incomes returned, by ownership. The first row displays household consumption and the other component of final demand.

The basic idea of the efficiency gain on the frontier can be illustrated graphically. This frontier can be reached by optimal allocations of factors of

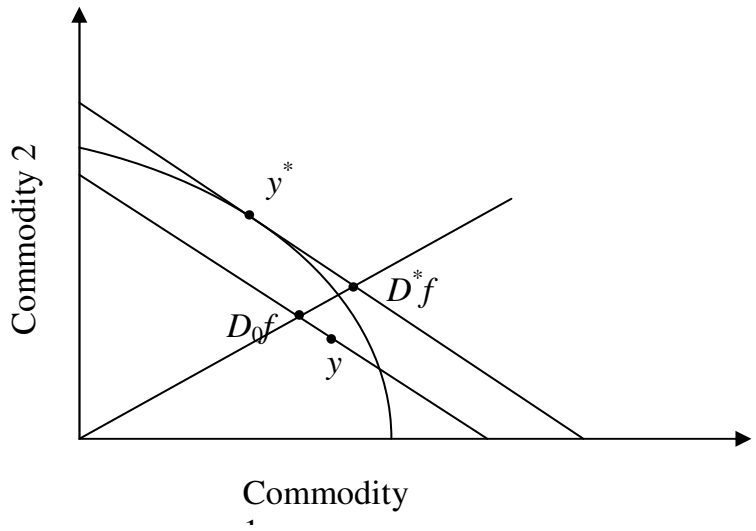
[5] In an economy like India, capital and land may not be mobile in the medium-run. Most of the capital and land are highly specialized due to its inherent technology, product-specific, etc.

production across the sectors and by re-allocation of trade with the rest of the world (Figure 2.1).

Table 2.1: A Schematic SAM

	Production Account	**Factors of Production**	**Households**	**Government**	**Capital Account**	**Rest of World**	**TOTAL**
Production Account	I-O		Household Consumption	Government Consumption	Investment Demand	Net Exports	Total Demand
Factors of Production	Value Added						Value Added
Households		Factor Income of Households					Total Household Income
Government Account			Taxes				Government Income
Capital Account			Household Savings	Government Savings		Foreign Savings	Total Savings
Rest of World							
TOTAL	Value of Output	Value Added	Total Household Expenditure	Total Govt. Outlay	Total Investment		

Figure 2.1: Movement towards the frontier and



In Figure 2.1, y and D_0f denote the actual production and domestic final demand, on the international trade budget line. As shown by ten Raa and Mohnen (2002), D_0f can be expanded to D^*f by producing y^* instead of y.

Notice that the optimal pattern of trade is reversed in Figure 2.1. The following linear program determines the optimal allocation

$$\text{Max } De\sum_{h=1}^{9} d_h f_h \text{ w.r.t. } D, x, t \text{ such that}$$

$$Ax + \sum_{h=1}^{9} d_h f_h D + g + \begin{pmatrix} t \\ 0 \end{pmatrix} \leq x$$

$$kx \leq K$$

$$lx \leq L$$

$$nx \leq N$$

$$-\pi t \leq -\pi t^0$$

$$x \geq 0$$

Parameters and exogenous variables:

f_h : column vector of h^{th} household's consumption share (21-dimensional)

d_h : a scalar of share of consumption demand of each h^{th} household in total consumption demand

e : a unit row vector

A: a 21x21-dimensional matrix of intermediate flow coefficients

g: a 21-dimensional vector of fixed final demand comprising of government consumption demand, investment demand.

K: a 21-dimension column vector of sector specific capital stock

N: total land endowment in the economy

L: total labour endowment in the economy

k: a diagonal matrix with sector-specific technical coefficients of capital

n: a diagonal matrix with sector-specific technical coefficients of land

l : row vector of technical coefficients of labour

π : a 19-dimension row vector of terms of trade in dollar term.

t^0: 19-dimensional vector of observed net exports

Endogenous variables:

x: a 21 dimensional column vector of economy's output

D: scalar of overall private consumption demand in the economy

t: a 19 dimensional vector of net exports

The dual problem reads:

$$\text{Min } r_1 K + r_2 N + wL - pg - \varepsilon\pi t^0 \text{ w.r.t. } p, r_1, r_2, w, \varepsilon \text{ such that}$$

$$pA + r_1 k + r_2 n + wl \le p$$

$$p\sum_{h=1}^{9} d_h f_h = e\sum_{h=1}^{9} d_h f_h$$

$$p = \varepsilon\pi$$

The primal problem expands the final private consumption demand (*D*) given the household groups weights, d_h. The weights will be adjusted as to equilibrate the model. The first constraint is the commodity constraint, i.e. the material balance, while next three constraints are for capital, land and labour, respectively. The fourth constraint states that the net exports valued at world prices cannot conflict the existing trade deficit.

In the dual problem shadow prices p, r_1, r_2, w and ϵ are for output, capital, land, labour and purchasing power parity, respectively. The first dual constraint reflects that the factor cost of production exceeds value added. For active sectors, there is equality (ten Raa, 1995). The second dual constraint takes care of the price normalization. The last constraint equalizes the prices of the tradable sectors with their opportunity cost under the assumption of free trade.

The idea is to compute the propensity to consume at the competitive prices for each household group and to equalize relative propensities to consume with the observed ones. If the propensity to consume of the first household group turns out disproportionately high, its higher consumption demand signals that we have attributed too much welfare to this group in the social welfare function. We adjust the weight (downward in this case) and re-compute the optimal allocation given by linear program. Through an iteration process, we arrive at the optimum pattern of consumption and income for each household group. In a solution to the linear program, the households consume $pf_h d_h D$,

whereas their incomes are $r_1\theta_K^h K + r_2\theta_N^h N + w\theta_L^h L$, given the household groups' (h = 1, …, 9) shares θ_K^h, θ_N^h and θ_L^h of the capital, land and labour endowments. The implied propensities to consume are $m_h^1(d) = (pf_h d_h D)/(r_1\theta_K^h K + r_2\theta_N^h N + w\theta_L^h L)$. The observed propensities to consume, $m_h^0(d)$, valued at competitive prices for current consumption are similar, but with the optimal consumption baskets $f_h d_h D$ replaced by the observed baskets. If a household category h has a low optimal propensity to consume, we rerun the linear program, giving it more weight in final consumption, d_h. There are eight independent such weights (one of the nine weights is determined by the adding-up condition) and the condition that nine household groups have equal optimal/observed ratios of the propensities to consume amounts to eight equations. In equilibrium, the optimal/observed ratios of the propensities to consume are the same for all household groups. Mathematically, the equilibrium is found as in ten Raa and Pan (2005).

2.3 Data

We use the SAM of Pradhan, Sahoo and Saluja (1999), with some adjustments. The intermediate flows in the SAM are based on the commodity-by-commodity matrix, which we have aggregated from the original 60 commodities down to 21. The economy is classified into 21 production sectors to take care of important economic activities. `Food-grains' has been separated from the rest of the agriculture sector for its vital role in poverty. 'Coal and lignite', and 'crude oil and natural gas' are the two components of primary energy. The primary energy requires higher investment in exploration and also due to high domestic demand a substantial amount of it is imported.

The sectors in the manufacturing are divided in such a way that capital goods are separated from consumer items like `food articles and beverages', `textiles', etc. in view of different capital structures. For the rapid development of the economy, the `cement and other non-metallic mineral products', which

are basically inputs to the construction sector have assumed importance. Their growth will give a fillip to the crucial housing sector as well. `Fertilizers' as a sector has got a big role to play in influencing the agriculture. The `petroleum products' are kept separately as these are by-products of the one of the important energy sectors, `crude oil and natural gases'. They are also crucial energy sectors whose prices have so far been administered and the economy is very sensitive to their price changes.

Households are classified according to their principal sources of income. There are four rural and five urban occupational household groups. The 1996 MIMAP-India Survey (Pradhan and Roy, 2003) provides the information on the factors of production, and the income and consumption distributions. Table 2.2 shows that the bulk of rural income derives from agriculture, while urban income stems nearly exclusively from the other activities. The rural agricultural households derive around 87 percent of their income from the agriculture. The other rural household groups derive between 87 and 89 percent of their income from non-agricultural activities.

Table 2.2: Sources of Income for Household Groups (in percentage)

Household Categories	Agriculture	Non-agriculture	Total
All-India	32.14	67.86	100
Rural			
Self employed in agriculture	87.12	12.88	100
Self employed in non-agriculture	12.87	87.13	100
Agriculture wage earners	88.52	11.48	100
Non-agriculture wage earners	10.32	89.68	100
Other Households	12.53	87.47	100
Total Rural	55.66	44.34	100
Urban			
Agriculture households	74.91	25.09	100
Self employed in non-agriculture	0.95	99.05	100
Salaried earners	0.9	99.1	100
Non-agriculture wage earners	2.19	97.81	100
Other households	1.03	98.97	100
Total Urban	2.46	97.54	100

Source: Pradhan and Roy, 2003.

Table 2.3 shows that the urban 'salaried class' (12% of the population) secures a big chunk of the wage bill (34%), whereas 'agriculture labour' (22% of the population) gets a meagre part (17%). The small 'non-agriculture self-employed' household group (5.4% of the population) lays claim to the bulk of capital income (33%). The rural 'cultivator' household group also enjoys a great share of capital income (20%), but they are many (24% of the population). This group dominates agricultural land.

Table 2.3: Percentages of income across household groups by sources

Household	Population	Wage income	Capital income	Land rent	Total
Total	100	100	100	100	100
Rural					
Cultivator	24.22	13.36	20.46	78.49	23.92
Agriculture Labour	22.08	16.85	0.46	0.56	9.97
Artisans	13.85	10.01	14.81	15.5	12.12
Other households	14.76	14.8	3.76	4.18	10.21
Urban					
Agriculture Households	1.24	0.74	1.62	1.28	1.06
Non-agriculture Self-employed	5.4	6.03	32.69	0	12.97
Salaried	12.19	34.34	14.26	0	24.04
Non-agriculture Labour	2.81	2.96	3.54	0	2.74
Other households	3.44	0.9	8.4	0	2.96

Source: Calculated from the SAM for India, Pradhan et al (1999)

Table 2.4 reveals that rural households have a rather uniform pattern of consumption, with the bulk spent on primary, mainly agricultural, goods. The vast majority of the urban households consume services.

Table 2.4: Composition of Household Expenditure

Household	Primary	Secondary	Services	Total	Share in Total spending
Rural					
Cultivator	41.16	26.10	32.74	100	0.12
Agriculture Labour	47.17	25.71	27.11	100	0.06
Artisans	41.18	28.08	30.75	100	0.06
Other households	42.23	29.07	28.70	100	0.05
Urban					
Agriculture Households	43.77	23.76	32.47	100	0.01
Non-agriculture Self-employed	35.07	24.86	40.07	100	0.06
Salaried	24.63	31.36	44.00	100	0.11
Non-agriculture Labour	44.37	25.32	30.31	100	0.02
Other households	19.08	27.46	53.46	100	0.02

Source: Calculated from the SAM for India, Pradhan et al (1999)

The benchmark coefficients for the factor input are given in Table 2.5. The Annual Survey of Industry (ASI) (Government of India, 1994-95) gives information on the number of employees engaged in the different registered manufacturing industries and their total emoluments. We compute the average wage rate for each registered industry. Because of the difficulty in procuring information on unregistered industries, we apply the wage rates of the registered industries to the unregistered ones. Application of the wage rates to the SAM based labour value added statistics, yields estimates of the numbers of employees in the manufacturing industries. Unfortunately, ASI does not give information on agriculture sectors, mining and quarrying, construction and service sectors. Using the information on the numbers of main and marginal workers engaged in these activities given by the Government of India (1991), we compute the benchmark wage rate for these sectors. An

unemployment rate of 6 percent is applied to get the labour constraint in the model[6].

Table 2.5: Factor prices and coefficients across the sectors

Sectors		Capital/ Output	Labour/ Output	Land/ Output	Average Wage*	Rent of Capital*	Rent of Land*
S1	Food grains	0.065	4.88	0.276	0.065	1.00	1.00
S2	Other agriculture	0.075	5.75	0.302	0.065	1.00	1.00
S3	Crude oil, natural gas	0.594	2.70		0.089	1.00	
S4	Other Mining and quarrying	0.454	2.03		0.089	1.00	
S5	Food products, etc.	0.133	0.48		0.172	1.00	
S6	Textiles	0.117	0.63		0.262	1.00	
S7	Other traditional manufacturing.	0.162	0.58		0.289	1.00	
S8	Petroleum products	0.268	0.15		0.461	1.00	
S9	Finished petrochemicals	0.276	0.13		0.461	1.00	
S10	Fertilizer	0.230	0.20		0.365	1.00	
S11	Other chemicals	0.225	0.23		0.365	1.00	
S12	Non-metallic products	0.170	0.51		0.236	1.00	
S13	Basic metal industries	0.156	0.18		0.444	1.00	
S14	Metallic products	0.157	0.55		0.309	1.00	
S15	Capital goods	0.175	0.49		0.449	1.00	
S16	Other Manufacturing	0.269	0.70		0.342	1.00	
S17	Construction	0.075	0.46		0.810	1.00	
S18	Electricity	0.277	0.30		0.383	1.00	
S19	Infrastructure service	0.377	0.80		0.311	1.00	
S20	Financial service	0.531	0.75		0.311	1.00	
S21	Other services	0.243	1.65		0.289	1.00	

Source: Calculated from the SAM for India, Pradhan et al (1999)
* Wages are calculated from Annual Survey of India (various issues), Government of India (1991) and rent to capital and land are assumed to be one at observed level.

We assume that land is used in agriculture only and we assume it is fully utilized. We assume that capital and land rents are uniform across sectors. Table 2.6 shows the capacity utilization rates for different sectors, taken from different sources.

[6] The unemployment rate is the ratio of unemployed to the total labour force based on daily status. The source is NSSO (1997).

Table 2.6: Capacity utilization and sources of information

Sectors	Capacity Utilization (%)	Sources
S1 Food grains	81	Gupta, et al (2000) for irrigation
S2 Other agriculture	81	Gupta, et al (2000) for irrigation
S3 Crude oil, natural gas	88	Indiainfoline.com (2003)
S4 Other Mining and quarrying	85	Government of India (1996) for coal
S5 Food products, etc.	49	Government of India (1992a)
S6 Textiles	69	Government of India (1992a)
S7 Other traditional manufacturing.	58	Government of India (2001)
S8 Petroleum products	88	Indiainfoline.com (2003)
S9 Finished petrochemicals	78	Government of India (2001)
S10 Fertilizer	90	Trivedi et al.(1998)
S11 Other chemicals	78	Directories-today.com (2003)
S12 Non-metallic products	71	Government of India (1992b) for Cement industry
S13 Basic metal industries	78	Government of India (1992b) for aluminium industry
S14 Metal products	55	Government of India (2001)
S15 Capital goods	83	Government of India (2001)
S16 Other Manufacturing	78	Government of India (2001)
S17 Construction	75	Indiainfoline.com (2003)
S18 Electricity	41	Economic Survey, 2000-2001,
S19 Infrastructure service	75	Indiainfoline.com (2003)
S20 Financial service	100	Authors' own assumption
S21 Other services	52	Govt. of India (1987)

2.4 Income Distribution and Poverty

This section of the study is based on Pradhan and Sahoo (2003). The measurement of poverty requires an estimation of the income distribution within the each group. The distribution will be used to evaluate the group poverty incidence. The implicit assumption is that, given the within-group variances, the intra-group distribution changes proportionally with the change in mean income. For within group distribution we use a lognormal frequency

distribution, $f(y)=\exp\frac{-[\log(y)-\mu]^2}{2\sigma}/(\sqrt{2\pi}\sigma)$; parameterised by the log-mean μ and the standard deviation σ.

The FGT poverty measure (Foster, Greer and Thorbecke, 1984) is suitable to estimate group-wise poverty. It is defined by $P_\alpha^h = \frac{1}{n^h}\sum_{i=1}^{q^h}\left[\frac{z - y_i^h}{z}\right]^\alpha$, $h=1,...,9$, where n^h is the population size in household group h (i.e. occupational class), q^h the number of people below poverty line, 'z' is the poverty line[7] and Y_i^h is the income of the i^{th} person in household group 'h'. α is a measure of poverty aversion; the most commonly used values are 0, 1 and 2. P_0 is the 'head-count ratio measure', P_1 is the 'poverty-gap measure' and P_2 the 'distributionally sensitive measure.' In this paper, we use only the head-count ratio of poverty measure; it is simply the fraction of households living below the poverty line.

When income distribution is given in the form of group data, the poverty measure requires a continuous income density functions, one for each household group, and the FGT poverty index can be expressed as $P_\alpha^h = \int_0^z \left(\frac{z-y}{z}\right)^\alpha f^h(y).dy \quad h=1,...,9$. By assumption of the lognormal distribution and a transformation, the 'head-count ratio' becomes $P_0 = N\left(\frac{\log z - \mu}{\sigma}\right)$, where N is the standard normal distribution.

For each household group we estimate of μ and σ using the MIMAP-India household survey data (see Table 2.7). We estimate the observed level P_0 for household groups by applying information on income distribution from the

[7] Poverty lines for rural and urban are taken from Pradhan and Roy (2003). Government of India (1993) estimated (nutritional) poverty line for Rural and Urban India for the year 1973-74 based on the pattern of consumption expenditures of households. Pradhan and Roy (2003) revised the 1993-94 poverty lines by using consumer price index number for agriculture labour and industrial workers for rural and urban areas respectively.

SAM. However, this estimated observed poverty ratios at the observed level could be different from that of officially reported by the Pradhan and Roy (2003) due to differences in assumption regarding distributions and other adjustments in the SAM (see Table 2.8).

Table 2.7: Parameters of lognormal distribution

Households	Log-mean (μ)	Standard deviation (σ)
Rural		
Cultivator	5.85	0.76
Agriculture Labour	5.33	0.60
Artisan	5.55	0.79
Other household	5.93	0.72
Urban		
Farmer	5.41	1.05
Non-agricultural Self-employed	6.36	0.89
Salaried Class	6.68	0.76
Casual Labour	5.54	0.82
Other Household	6.47	1.35

Source: estimated from Pradhan and Roy, 2003

Table 8: Poverty head-count ratio P_0 at observed period

Households	Poverty (1994-95)	
	Estimated	Official*
Rural	0.3943	0.3979
Cultivator	0.3679	0.2946
Agriculture labour	0.5497	0.5675
Artisan	0.3586	0.4404
Other households	0.2041	0.2451
Urban	0.2837	0.2245
Farmer	0.7396	0.6179
Non-agricultural Self-employed	0.3860	0.2389
Salaried class	0.1424	0.1038
Casual Labour	0.6103	0.5910
Other household	0.2135	0.2912

*Pradhan and Roy, 2003 (MIMAP-India Survey).

The optimum solutions of our general equilibrium model yields set of new relative prices and mean income of household groups, which are used to

calculate the changes in poverty line and mean income (μ)[8] from the observed level. We measure inequality by the Gini coefficient.

2.5 Results and Implications

The main objectives of the economic reforms in India have been to accelerate the growth of the economy by removing the distortions, domestic as well as trade, and to mitigate the poverty situation. Table 2.9 shows that since 1983 the rural poverty ratio is higher than the urban. The poverty ratio declines since the late eighties.

Table 2.9: Poverty Head-count Ratio

Year	Rural	Urban	Total
1973-74	56.4	49.0	54.9
1977-78	53.1	45.2	51.3
1983	45.7	40.8	44.5
1987-88	39.1	38.2	38.9
1993-94	37.3	32.4	36.0
1999-00	27.1	23.6	26.1
2007 *	21.1	15.1	19.3

Source: Government of India (2003)
*Poverty projection for 2007.

If these policies of economic reform were realized to the fullest theoretical extent, the competitive pressure would twist the distribution of income. The Indian economy could expand by a factor 1.42, indicating that it operates at an efficiency level of 70 percent.[9] This would come with a great increase of in the Gini coefficient, from the observed 0.2739 to 0.3424. However, poverty (the head-count ratio P_0 defined in Section 4) would decline for the overall rural as

[8] Our general equilibrium model provides the income for each group. If the log variances are known, then log means can be calculated from the following relationship $\mu = \ln(y) - \frac{1}{2}\sigma^2$, where y is the arithmetic mean income, σ^2 is log variance and μ is the log mean (Dervis, de Melo and Robinson, 1984).
[9] As 1/1.42 = 0.70.

well the overall urban households (see Table 2.10). The decline is quite significant for the urban household and marginal for the rural households.

Table 2.10: Household consumption weights, income inequality and poverty head-count ratio

Households	Ratio of Optimum to Observed			Percentage Change in Poverty H-C
	Consumption Weights	Income	Consumption	
Rural				**-0.62**
Cultivator	0.792	0.931	1.12	2.44
Rural Agricultural labour	0.795	0.935	1.13	3.51
Artisan	1.072	1.261	1.52	-11.69
Rural Other	0.881	1.036	1.25	-2.10
Urban				**-11.38**
Urban farmer	1.157	1.360	1.64	-17.39
Urban Non agricultural self	1.458	1.714	2.07	-16.72
Urban Salary	0.996	1.171	1.41	-5.57
Urban Casual labour	1.196	1.406	1.70	-23.86
Urban Other	1.513	1.779	2.15	-15.42
Gini Coefficient	0.2739			0.3424
Expansion vector	1.00			1.42

When the economy is allowed to be fully competitive, factors are fully utilized and the mobile factor, labour, is reallocated to the sectors with strong demand. The assumption of labour mobility gives rise to a single competitive wage rate. It is seen to be lower than the benchmark average wage (See Table 2.11). The rents to capital and land are determined by the interplay of demand and supply of each sector; and differ by industries. We observe that the demand for capital is stronger than that for labour and land. Land used in the sector 'other agriculture' is non-binding in the optimum, yielding a zero shadow price, while land used in the 'food grains' sector marginally gain in factor reward.

Table 2.11: Change in output, prices of factors and commodities

Sectors		Ratio of Optimum to Benchmark				
		Factor Prices			Prices	Output
		Labour	Land	Capital		
S1	Food grains	0.92	0.111		1.005	1.000
S2	Other agriculture	0.92	0.00		1.005	0.766
S3	Crude oil, natural gas	0.92		0.94	1.005	1.136
S4	Other Mining and quarrying	0.92		1.04	1.005	1.176
S5	Food products, etc.	0.92		2.43	1.005	2.041
S6	Textiles	0.92		2.72	1.005	1.449
S7	Other traditional manufacturing.	0.92		2.86	1.005	1.724
S8	Petroleum products	0.92		1.36	1.005	1.136
S9	Finished petrochemicals	0.92		1.56	1.005	1.282
S10	Fertilizer	0.92		1.45	1.005	1.111
S11	Other chemicals	0.92		1.70	1.005	1.282
S12	Non-metallic products	0.92		2.25	1.005	1.408
S13	Basic metal industries	0.92		2.06	1.005	1.282
S14	Metallic products	0.92		3.21	1.005	1.818
S15	Capital goods	0.92		2.36	1.005	1.205
S16	Other Manufacturing	0.92		1.96	1.005	1.282
S17	Construction*	0.92			0.610	1.062
S18	Electricity*	0.92			0.527	1.362
S19	Infrastructure service	0.92		1.89	1.005	1.333
S20	Financial service	0.92		1.26	1.005	1.000
S21	Other services	0.92		4.10	1.005	1.923

* These are the non-tradable sectors.

Rent on capital in all the industries other than the intensive-intensive primary sectors would increase, viz. agricultural sectors (S1 and S2), 'crude oil and natural gas' (S3) and, 'other mining and quarrying' (S4), and non-tradable sectors viz. 'construction' (S17) and 'electricity' (S18) (See Table 2.10). We observe that agriculture sector has no comparative advantage. Agricultural output would not increase or drops (in the 'other agriculture' sector). Labour is thus released to the manufacturing and service sectors in which enjoy a strong comparative advantage. This observation is very close to that of Wood and

Calandrino (2000). Labour is absorbed by the sectors with low capacity utilization rates.

As competitive factor prices of capital increase more than the other factors, we expect that household groups owning more capital stand to gain. Table 5 shows that among *rural* household groups, the 'cultivator' households own the most capital as well as land. Their income would decline though, because competitive land rent is low. The low competitive wage and the near non-existent of capital and land rents in agricultural sectors adversely effect the income of the rural 'agriculture labour' and 'cultivator' classes. Only the 'artisan' household group stands to gain. The worst affected household group in the economy is the rural 'agricultural labour', which has very low share of capital and large labour endowment.

Urban household groups fare better under competition. The 'salaried class' with maximal labour endowment experiences lowest gain in income, while greatest gain is enjoyed by the 'non-agricultural self-employed' household group, which own capital (See Table 2.5 and 2.10).

The wide income disparity between the rural and urban household groups gives rise to increase in the Gini coefficient. Adverse income effects among most rural household groups explain the low gain in the rural poverty ratio. Only the 'artisan' household group shows a significant decline in poverty; the 'agricultural labour' suffers heavily from increase in poverty ratio (See Table 2.10). The poverty ratio increases by around 19 percent for rural 'agriculture labour' household group. As the ratio is already high for this group, (0.55 according to Table 8), the contribution is disastrous to this group. On the other hand, the urban groups would enjoy a sharp decline in poverty.

2.6 Conclusion

The efficiency pursuit of the Indian economy comes at the cost of adverse income effects, particularly among the rural household groups. The income distribution would become more skewed. Households dependent on labour and

land tend to suffer. The urban household groups attain a better welfare distribution, with significant decline in the poverty headcount ratio. Not so for the rural household groups; the only rural household group, which stands to decline in poverty, is the ‘artisan’. The worst victim of competition is expected be the ‘agricultural labour’. Similarly, among the urban household groups, the relative gain for ‘salaried class’ is low.

Chapter 3

Competitive environment, wage inequality and efficiency of the Indian economy

3.1 Introduction

Issue for developing countries is the skilled-unskilled gap and it gathers currency once these countries attempt to liberalize their economies in the pursuit of a competitive market and improved efficiency. Besides international trade and technology change, as widely accepted, human capital formation also significantly contributes to the wage inequality in these countries. Tinbergen (1975) argued that the opposing effects of technology (skilled labour demand) and education (skilled labour supply) on the relative wage determine the inequality. Competitive environment can affect both the demand and supply of skilled labour and hence the education process. Normally, wages paid to the skilled and unskilled labour may not be according to their productivities, which are evaluated by the competitive wages, while the economy might be performing below its potential. This study attempts to capture all these issues for the Indian economy focusing on the role of human capital formation.

For long, Indian industries were characterized by inefficiency, high costs and uneconomical means of production with pervasive government control. With a view to improving efficiency and global competitiveness, liberalization policy and economic reforms were introduced in a big way at the outset of 1990s. Between 1987 and 1993, returns to education had increased significantly for middle and secondary levels, while it remains stagnant for primary and higher education (Bargain, et al, 2007). On the contrary, returns to middle and secondary level education have fallen in 2004 over 1993 while returns to higher education (college) have grown (Asian Development Bank, 2007). What we could gather from the above observation that prior to 1993

(pre-liberalization period), lack of demand for basic education could be reason for higher premium for middle and secondary education. A study by Pradhan and Subramanian, (2000) based on MIMAP-India Survey (Pradhan and Roy, 2003) for 1994-95 viewed that lack of interest in schooling (demand for education) because of lack of expected future earnings is the major factor explaining low enrolment and high dropouts rates in India. Lack of market for higher education could possibly explain decline in returns to higher education during this period. Post liberalization period is marked by much higher productivity growth and increase contribution from service sector and skilled-based manufacturing industries (Virmani, 2005; Bosworth et al 2006), which have possibly resulted in increase in premium for higher education[10]. It is unquestionably believed that India still requires higher pace of reforms towards the creation of a competitive market (Bajpai and Sachs, 1997; Fischer, 2000). It is expected that there would be a movement of the economy towards static and dynamic efficiency if the economy is large and open resulting in competitive factor prices, and gain in productivity and efficiency. This might change the demand for education and reorient the market-based supply. Our study tries to evaluate wage inequality and efficiency of the economy in the face of a competitive pressure over a decade of strong reforms between 1994 and 2002.

Recently, the productivity and efficiency aspects of growth have attracted considerable attention in the literature, viz. real business cycle (RBC) models (Kydland and Prescott, 1982 and Prescott, 1986) and endogenous growth models in mid-eighties (Romer, 1986, Lucas 1988). All these analyses emphasize the role of productivity to analyse the dynamics of economic growth. ten Raa and Mohnen (2002) propose that the total factor productivity (TFP) growth comprises three terms: Solow residual, efficiency change (X-efficiency and allocative efficiency) and terms of trade effect. This is evaluated

[10] Absolute overall skill premium has gone up in 2002 over 1994 (see Table 3.1). However the overall wage ratio between skilled and unskilled has marginally gone down, because of better reward to the unskilled labour relative to the skilled.

not by using domestic prices but by competitive world prices. Following ten Raa and Mohnen (2002) we combine frontier approach with the applied general equilibrium framework, which captures the inter-linkages of the economy. Welfare of the economy is maximized subject to commodity, factor and trade constraints. This is compatible with the Negishi (1960) welfare program, which shows that a welfare optimum with non-zero welfare weights represents a competitive equilibrium such that all consumers satisfy their budget constraints. Competitive environment pushes the economy to its best production frontier with efficient utilization and reallocation of resources, and reorientation of trade. A production frontier reflects the potential of an economy. Efficiency of an economy is the performance of it compared to its potential. A perfectly competitive market would remove the existing inefficiencies of the economy. An important aspect of our study is to incorporate human capital formation (education process) into the productivity-efficiency analysis as a factor for endogenous change in skilled labour supply that captures returns to education in the long run. Human and physical capital formations are two dynamic factors in our model.

Trade liberalization has shown divergent results for skilled-unskilled wages in case of countries from Latin America (Hanson and Harrison, 199), while the East Asian countries show the convergence (Wood, 1994, 1999). Seminal work has gone into the issue of wage differential between skilled and unskilled labour in both developed and developing countries (Wood 1999; Katz and Autor, 1999; Williamson 1999). The explanations include skilled-biased technological change, international trade, intuitional and supply-demand factors (Katz and Murphy, 1992; Learner, 1996; Krusell, et al. 1997; Berman et al., 1998; Kiley, 1999; Machin 2002). In the Indian context, studies have shown that trade openness has, in fact, has an exacerbating effect on the skilled-unskilled wage gap (Pradhan, 2002; Marjit and Acharya, 2003; Beladi and Chakraborty, 2004; Dutta, 2004). However, no clear picture has emerged as regards to the effect of education on the skill premium during the period of liberalization. While Pradhan (2002), with the help of a general equilibrium

model, observed that even large increases in the access to education preserve the wage inequality, an econometric study by Dutta (2005) found that despite the increase in the skill premium education has helped narrowing wage inequality.

Relative wage, i.e. ratio of skilled wage to unskilled wage, defines the wage inequality. Factors in a competitive market are paid according to their marginal productivities. Competitive input prices would reflect factor productivities. The resultant competitive wage inequality marks the productivity inequality between skilled and unskilled labour, which is the skill productivity. Our study appraises wage inequality by comparing it with the productivity inequality. If the competitive wage inequality were higher than the observed wage inequality for a particular period, it would suggest that the productivity inequality is higher than the wage inequality. Our analysis considers two periods, 1994 and 2002, which spans the reform process of the economy and education. It can be noticed from the Table 3.1 that the relative wage has marginally declined between 1994 and 2002. We find that relative productivity has declined significantly during this period; in the initial period relative wage remains lower than the relative productivity and it's other-way-around in the end period.

We introduce a decomposition exercise that captures the contribution of various factors, trade efficiency, human capital formation, physical capital formation and static allocative efficiency (efficient allocation of resources within a period), to the efficiency of the economy and to the ratio of relative productivity of skilled and unskilled labour to the relative wage. The decomposition is based on an extended Fisher Index approach that takes care of path independence due to non-linearity of the model. As elasticity of substitution between the skilled and unskilled labour in production process is expected to play important role in influencing wage differentials, we conduct an experiment with low as well as high degree of elasticity of substitution. The rest of the paper is divided into four sections. The theoretical model is presented in the Section 2. Section 3 analyses the basic data set and calibration.

The model results are discussed in the Section 4, while Section 5 gives conclusion and policy implication.

3.2 The Model

We determine the frontier of the economy by maximizing the vector of total final demand excluding the investment demand and net export subject to commodity, factor and trade deficit constraints. We assume Leontief preference, which keeps the relative compositions of the total final demand as fixed. Considering a small open economy, producers of tradable sectors take world prices as given. The pattern of trade is endogenous, constrained by the observed deficit on the balance of payment.

Our interest is to evaluate relative wages of skilled to unskilled labour between 1994 and 2002 by comparing them with their relative productivities. Education is considered to be responsible for the skill formation over this period; change in skilled labour supply is endogenous in the model. We incorporate supply and demand of education into the model linking the two periods. The transformation of unskilled to skilled labour is a dynamic process. The investment process also captures the capital formation in the second period. Now assuming that agents live in both the periods, their inter-temporal preference includes second period's utility function as well. A commonly used additively separable inter-temporal preference function is assumed, where the second period's utility is added with a discount factor, β $(0 \le \beta \le 1)$. The implicit discount rate is $\mu = (1-\beta)/\beta$. We follow a welfare maximization program (see Negishi, 1960) that maximizes additive intertemporal preference, $\sum_{t=0}^{1} (\beta)^t D^t$, subject to commodity, resource and trade constraints. The expansion factor is defined as $c^t = (D^t)^* / D_0^t$. $(D^t)^*$ is the value of aggregate final demand at the optimum for period *t*, while D_0^t is the observed value. Inverse of expansion factor measures the efficiency in the economy in period *t*. The inefficiency of the economy equals $1 - 1/c^t$.

Producers face a nested production function that is single period in nature. The Leontief production function that represents non-substitutability between composite intermediate inputs and value added forms the first rung of the nested structure. Leontief input-output function also explains the composite intermediate inputs as inputs are used in fixed proportions to the level of output. Value added follows a Cobb-Douglas function of capital and composite labour. Composite labour is a CES aggregation of skilled and unskilled labour. We assume capital is sector specific, which gives decreasing returns to scale with respect to composite labour. An economy may completely specialize in few sectors due to world price change or nearly specialize if the elasticity of substitution between factors is high. However, this is not a realistic scenario for a country like India. The most realistic way to handle this problem is to assume sector-specific capital, in the Ricardo-Viner spirit[11]. Most of the capital is highly specialized due to its inherent technology, product-specific, etc. The model allows both skilled and unskilled labour to move freely across the sectors in a competitive environment. We assume "downward mobility" of skilled labour to join the unskilled pool if they are unemployed in the skilled labour search[12].

[11] Abrego and Whalley (2000) contended that fixed factor assumption can remove specialization, but this has the property that price shocks can be largely borne by the fixed factors, rather than by the mobile skilled and unskilled labour types.

[12] This ensures that competitive wage of skilled would be at least as big as that of unskilled.

$$Max \sum_{t=0}^{1} (\beta)^t D^t \quad w.r.t. \quad D^t, X_i^t, T_g^t, I^{t-1}, K_i^t, L_{s_i}^t, L_{u_i}^t, \sigma^{t-1}, \Delta S \geq 0 \quad s.t.$$

$$(1) \quad \sum_j A_{ij}^t X_i^t + f_i^t D^t + \tau_i^t I^t + T_g^t \leq X_i^t$$

$$(i, j = 1, \ldots, 11; 10 = education; g \subset i)$$

$$(2) \quad X_i^t \leq \theta_i^t (K_i^t)^{(1-\phi_i^t)} [\alpha_i^t (L_{s_i}^t)^{\rho_i} + (1 - \alpha_i^t)(L_{u_i}^t)^{\rho_i}]^{\phi_i^t / \rho_i}$$

$$(3) \quad \sum_i L_{u_i}^t \leq N^t - \sum_i L_{s_i}^t - \sigma^t$$

$$(4) \quad \sum_i L_{s_i}^t \leq S^t \quad (t = 0), \quad \sum_i L_{s_i}^t \leq S^{t-1} + \Delta S \quad (t = 1)$$

$$(5) \quad K_i^{t+1} \leq K_i^t + \delta_i I^t$$

$$(6) \quad -\sum_g \pi_g^t T_g^t \leq B^t$$

$$(7) \quad \Delta S = \xi(\sigma^t), \quad \sigma^t = \lambda^t X_{11}^t \quad (t = 0)$$

Endogenous variables:

D^t: Aggregate final demand excluding investment and net export in period t

I^t: Aggregate investment demand in the initial period

X_i^t: Output of i^{th} sector in period t

T_g^t: Net exports of gth tradable sector in period t; g$\neq$ 5, 6 and 10

ΔS: Addition to stock of skilled labour in the end period over the initial period

σ^t: Stock of unskilled labour force going for education in the initial period

$L_{u_i}^t$: Demand for unskilled labour for period t respectively by i^{th} sector

$L_{s_i}^t$: Demand for skilled labour for period t respectively by i^{th} sector

Exogenous variables:

β: Inter-temporal time-discount factor, takes value between 0 and 1

A_{ij}^t: Intermediate demand in period t

f_i^t: Share of total demand for i[th] sector in period t

I^t: Aggregate investment demand in the end period

τ_i^t: Share of total investment demand coming from i[th] sector in period t

B^t: Observed trade deficient for period t

π_i^t: Terms of trade in period t

λ^t: Coefficients of unskilled labour joining education with respect to educational output in initial period

ξ: Coefficient of additional skilled labour stock in the end period with respect to labour joining education in the initial period

δ_i: Sector-wise rate of increase in investment in the end period, 1, over the initial period 0

σ^t: Stock of unskilled labour force going for education in the end period

N^t: Total population of labour force in period t

S^t: Supply of skilled labour in period *t*

C_i^t: Supply of capital stock in period t

θ_i^t: Cobb-Douglas shift parameters for period t

ϕ_i^t: Cobb-Douglas share parameters for composite labour for period t

α_i^t: Share parameters of skilled and unskilled labour for period t

ρ_i: Substitution parameters between skilled labour and unskilled labour[13]

The first constraint of each period is the commodity constraint, i.e. material balance for tradable and non-tradable sectors, while the second constraint represents the CES nested production function. Next three

[13] ρ_i is substitution parameter between skilled and unskilled labour, which is defined as $(\delta - 1)/\delta$, where δ is the elasticity of substitution

constraints are for unskilled and skilled labour, and capital respectively. The skilled labour demand in the initial period is constrained by an exogenously given skilled labour supply, and in the second period by number of initial period skill labour plus additional skill supplies over two periods (sees constraint 4). With the total labour supply (N^1) in period 1 as exogenously fixed and a part of the labour joining school (σ), the residual determines the supply of unskilled labour (3). We allow unemployed skilled labour to join the unskilled labour pool in both the periods, which is captured by the second right hand side term of the unskilled constraints (3). Basically, unskilled wages sets the minimum wages for the skilled labour in constraint (3), while the shadow prices from constraints (4) reflect competitive skill premiums. Competitive skilled wage is the unskilled wage plus the competitive skill premium. Capital demand constraint (5) results in competitive rents for initial period and end period. Constraint (6) states that net exports valued at world prices cannot exceed the existing trade deficit for each period. Shadow prices associated with each constraint, i.e. commodity, production function, unskilled labour, skilled labour, capital and trade, (P_i^t), ($P_{v_i}^t$), (w_u^t), ($P_{S_i}^t$), (r_i^t) and (ε^t), represent competitive prices of output, value added, unskilled wage, skill premium, rent to capital, and purchasing power parity for both the periods.

We have captured the dynamic process of capital and skill formation in a very simplistic way. Capital formation depends on the initial period investment. Addition to capital, net of depreciation grows at a constant long-run rate of investment in each period. Hence, our capital formation in second period, 2002, depends on the initial period capital stock plus a fixed rate of increase in initial investment (see constraint 5). Last constraint (7) captures the process of skill formation with the help of education. There is 8-year gap between 1994 and 2002. Every year, a portion of the potential work force joins the school or training, i.e. education sector, in order to be transformed as skilled labour in some point of future. Education or training does not necessarily take one year to transform the unskilled to skilled labour. However, every year there is a net turnover of skilled labour. In period 1, number of

unskilled labour goes for education is proportional to educational output, λ^1. Change in stock of skilled labour force in period 2 (2002) over 1 (1994) consists of 8 sub periods. We assume that educational output grows at a fixed rate over the sub-periods, so also the number of unskilled labour going to education each period. Considering education sector's output as number of educated students, net of enrolments and dropouts, the change in stock of skilled labour in next sub-period is assumed to be proportional to the number of labour joining education in the previous period, ξ.[14] Shadow prices attached to constraints 9 and 10 give the cost of skill formation for 2002 over 1994 (χ_c), and opportunity cost of going for education (χ_e) respectively in the optimum. In a fixed duration scenario as our concern is about the skill formation between two-time period, education stops playing any role in transforming the labour into skilled for periods afterward 2002. Hence, we consider the amount of workforce (σ^2) going to education in the end period as exogenous. They could be treated as the 'reserved army' for he future.

First order condition of the model is reported in the Appendix of the paper. The dual of the skilled labour constraint (A5) gives the static and dynamic competitive premiums for 1994 and 2002 respectively.

$$P_s^0 = w_s^0 - w_u^0$$

$$P_s^1 = w_s^1 - w_u^1$$

Education process culminates in the second period (2004) resulting in competitive skill premium. Conditions A8 and A7 show that the equivalence of competitive skill premium in the second period with the cost of skill transformation, which should be equivalent to competitive unskilled wage forgone by going for education plus the cost of education.

$$P_s^1 = \chi_c$$

$$\chi_c \xi = w_u^0 + \chi_e$$

[14] This is similar to poisson process where the distribution of intervals between successive occurrences is exponential, implying a fixed rate of occurrence.

Competitive consumer price of education at the optimum consists not only of the cost of producing it, but unskilled wage forgone in the first period net of competitive skill premium the student expects while becoming skilled in the second period (see A3, A7 and A8).

$$P_{11}^0 = \sum_j A_{11,j}^0 P_{11}^0 + P_{v_{11}}^0 + w_u^0 - P_s^1 \xi$$

Returns to education, in our case, would be the benefit accrued to labour going for education to become skilled instead of remaining as unskilled, i.e. ratio competitive premium to competitive unskilled wage (P_s^1 / w_u^1).

Equation A1 establishes price normalization condition for the general equilibrium model and also implicitly establishes that equilibrium prices and wages are discounted value of the future prices and earnings.

$$\sum_i f_i^0 P_i^0 = 1$$

$$\sum_i f_i^1 P_i^1 = \beta$$

The study focuses on the efficiency of the economy and the relative wages under a competitive market for the year 1994 and 2002. We decompose the efficiency and the ratio of the relative productivity to the relative wage into the contributions of various factors e.g. (a) trade efficiency (b) physical capital formation, (c) human capital formation, and (d) static allocative efficiency. Due to nonlinearities in the model, sequence of decomposition can make difference in evaluating the significance of each of the causes on the final effect. Often in computable general equilibrium models (CGE) there is an interest to split the total effect of a package of shocks into individual or group effects. Harrison et al. (2000) propounded a method of decomposing the endogenous changes from a general equilibrium simulation into sources attributable to each of the exogenous shocks by using an arbitrarily accurate approximation to the linear path. Shorrocks (1999) proposed a decomposition method for sources and causes of poverty and inequality, based on the Shapley value. According to this, the contribution of any given source of income to overall change in indicator can be interpreted as the expected marginal impact

of the factor when such an expectation is made over all possible sequence of elimination, which satisfies the property of symmetry and perfect decomposition. Both of the above methodologies follow additively decomposition, which decompose the absolute difference. We are interested in comparing the relative wages (wage inequality) with their relative productivities (productivity inequality), i.e. analysing the ratio of relative productivity to the relative wage for both the periods. Efficiency of the economy is measured by the ratio of output to potential output. In our case, it will be more interesting and relevant to decompose the relative difference than the absolute difference. Hence, our decomposition mythology follows Ang et al. (2004), who proposed an alternative approach given in the multiplicative form where the relative difference is given by the ratio.

Ang et al (2004) extended the Fisher index to *n-factor* model by taking the geometric average of all the combinations of the Laspeyres and Paasche indices, which satisfies the factor reversal test as well the perfect decomposition. Suppose the model is $V = f(X_1,...,X_n)$ and the set $N = \{1,2,3,4)$. Aggregate value changes from V^0, the observed value to V^*, the optimum. The multiplicative decomposition is represented by $\frac{V^*}{V^0} = D_T D_E D_I D_F$, where D_T, D_E, D_I and D_F represent the decomposed individual effect of trade efficiency, human capital formation, physical capital formation and static allocative efficiency. Let us define the functions $V(S) = f(X^*_{l\in S}, X^0_{m\in N/S})$. Individual factor's contribution can be represented by $D_i = \prod_{\substack{S\subset N \\ i\in S}} \left[\frac{V(S)}{V(S/\{i\}}\right]^{\frac{(s-1)!(n-s)!}{n!}}$ where *S* is the subset of *N* and *s* is the cardinality of *S*[15]. This multiplicative form is similar to presenting the decomposition in indices.

[15] The mathematical description is close to Ang et al (2004). Appendix II gives detailed formulae for all the components.

3.3 Data and Calibration

The basic data on sector-wise intermediate flow, final demand, investment, net-exports, output and value added of capital and labour for the years 1994 and 2002 are based on the social accounting matrices (SAM) from Pradhan, et al. (1999) and Pradhan et al. (2006)[16]. The economy is classified into 11 major production sectors including education. The original SAMs do not categorize labour according to type of education and hence skill. The unskilled labour is defined as labour having education primary or below, while the skilled ones are above primary level of education. We used employment survey conducted by National Sample Survey Organisation (NSSO) 50th round, for the year July 1993- June 1994, NSSO 55th round for the year 1999-2000 and 58th round for 2002 to calculated sector-wise average wage rates and employment for the 1st and 2nd period according to level of education. Labour force is defined as persons engaged for longer time during the past year in any one or more work related economic activities (principal and subsidiary status). Working age of labour force is taken as between 14 and above as defined by government of India. We admit that our employment figure may be underestimated to that extent of overlooking child labour. On the basis of the above-mentioned NSS data the total labour force is split into working population, attending school and seeking for job (unemployed). Unskilled labour is defined as labour having education primary or below and skilled labour as having education above primary[17].

Values of sector-wise output, net exports, intermediate demand, final consumption and investment demands net of indirect taxes in real terms for

[16] A brief description about the SAM is mentioned in the Chapter 2 (Section 2.2). SAMs for 1994 and 2002 are reported in the Appendix III.

[17] Primary education is essential for good quality unskilled work in modern manufacturing and services, low levels of education in the labour force result in low quality of service and mass consumer goods while secondary education ensured that labour was gradually able to undertake the semi-skilled jobs that opened up as the economy moved to middle income level (Virmani, 2006).

1994 and 2002 are computed by using GDP price deflators calculated from information provided in the National Accounts Statistics (Government of India, 1994, 2006). Terms of trade reflect value of Indian tradable commodities in the world market. We use the Global Trade Analysis Project (GTAP) database, which provides fairly detailed sector-wise value of imports at Indian as well as world market to get the terms trade for year 1995 and 2001 (www.gtap.agecon.purdue.edu/databases). For choosing value of time discount factor, β, we need to find time discount rate, the choice of which is a difficult issue, particular for developing country. We consider annualised real interest rate as a proxy for the time discount rate. We use lending rates and wholesale price indices (WPI) inflation to capture the real interest rate[18]. The real interest rate remains at the lowest in 1994 (2.40) due to high inflation and at the highest in 1996 (10.14). However, more or less it remains stable till 2002. We used geometric average of the real interest rates over the period between 1994 and 2002 in order to get a suitable proxy for our time discount rate. The average annualised estimated rate is found to be 8.6 percent[19]. Using this annualised rate over 8 years from 1994 till 2002, our value of time discount factor, β, turns out to be around 0.5.

The data shows that sector-wise skilled-unskilled wage differentials have no clear direction over time (see Table 3.1). The gap has increased for sectors like 'agriculture', 'heavy industries', 'transports and storage', and 'wholesale and retailed trade' sectors; it has in fact declined for other sectors. We can see that there has been increase in supply of skilled labour relative to unskilled for all the sectors except for the 'construction' in 2002 over 1994. We may support this observation with significant increase in final demand and production of 'education' in 2002 (see Table 3.1). The all India average figures

[18] JP Morgan (2007) explains the reason for considering lending rate and WPI for the estimation.

[19] A study by Shanmugam (2006) on the rate of time preference in India estimated that real discount rate ranges from 7.6 to 9.7 percent.

show that there has been only marginal increase in skilled-unskilled wage difference from 1994 to 2002 with big increase in the supply of skilled labour over the unskilled.

Table 3.1: Skilled-unskilled wages and labour supply, skill premiums, real output and final demand between 1994 and 2002

Sectors	Ratio of skill to unskilled wages		Ratio of skilled to unskilled labour		Ratio of 2002 to1994		
	1994	2002	1994	2002	Skill premiums	Real Output	Real final demand
Agriculture and allied	1,30	1,58	0,19	0,39	1.80	1,19	1,12
Mining and quarrying	2,03	1,91	0,33	0,57	1.73	1,52	3,43
Light manufacturing	1,98	1,84	0,37	0,69	1.25	1,67	2,42
Heavy manufacturing	2,26	2,44	0,92	1,40	1.38	1,94	1,15
Construction	1,58	1,46	0,31	0,55	1.03	1,79	2,01
Electricity, gas and water	1,72	1,64	1,75	4,42	4.84	1,46	1,97
Transports, storage	1,69	1,84	0,81	1,40	1.14	1,67	2,40
Wholesale, ret. trade	1,78	1,83	0,81	1,31	2.61	1,77	2,07
Finance, insurance, real est.	3,39	2,97	10,19	11,70	1.41	2,60	2,85
Education	3,70	2,92	1,17	2,18	1.09	5,65	5,75
Other services	3,70	2,92	1,17	2,18	1.26	2,28	2,19
All Sectors	2.95	2.91	0.38	0.64	1.19		

As we could see our data section that for the computation of the primal model we can get most the information from the SAM and other datasets. However, one would face difficulties in getting estimated values of CES production function, for which we followed calibration technique that is popular in applied general equilibrium modelling[20]. Elasticity of substitution parameters play crucial role in calibration exercises. Usually in applied general

[20] For details on calibration, see Shoven and Whalley (1984), Howitt (1995), Sims (1996), Hansen and Heckman (1996), Kydland and Prescott (1996) and Dawkins, et al. (2001)

equilibrium studies, these are acquired through either from econometrically estimation or with some guesstimates, i.e. prior knowledge or outside information. We would experiment our study by varying the elasticity parameters with low value of 0.5 and the significantly high one, 2.5, across the sectors and we assume that these parameters do not change over time[21]. Other technology parameters are calibrated for the observed economy, which remain unaltered during transition to frontier in particular period, but change over time period.

Our nested production function can be split into Cobb-Douglas function of capital and composite labour, and the composite labour as CES function of skilled and unskilled labour.

$$(8) \quad X_i^b = \theta_i (K_i^b)^{(1-\phi_i)} (L_i^b)^{\phi_i} \qquad i = 1,....,11$$

$$(9) \quad L_i^b = [\alpha_i (L_{s_i}^b)^{\rho_i} + (1-\alpha_i)(L_{u_i}^b)^{\rho_i}]^{\frac{1}{\rho_i}} \qquad i = 1,....,11$$

Assuming constant returns to scale as in (8) and (9) the producer's profit maximization will lead to equality of factor rewards with their marginal value product. With algebraic manipulation of the first order conditions of the profit maximization program with respect to demand for capital, skilled and unskilled labour, we can derive the following equations.

$$(10) \quad r_i^b = \frac{v_i^b (1-\phi_i) X_i^b}{K_i^o} \qquad i = 1,....11$$

$$(11) \quad w_{s_i}^b = w_i^b \alpha_i (L_{s_i}^b / L_i^b)^{\rho_i - 1} \qquad i = 1,....11$$

$$(12) \quad w_{u_i}^b = w_i^b (1-\alpha_i)(L_{u_i}^b / L_i^b)^{\rho_i - 1} \qquad i = 1,....11$$

Given exogenously the information on the sector-wise output, capital, total labour, skilled and unskilled labour, value added prices, total wages and skilled and unskilled wage (X_i^b, K_i^b, L_i^b, $L_{s_i}^b$, $L_{u_i}^b$, v_i^b, w_i^0, $w_{s_i}^b$ and $w_{u_i}^b$) at the observed

[21] The low elasticity of substitution between skilled and unskilled labour is a plausible assumption for a country like India. Jung and Thorbecke (2003) have also taken similar number for some African countries.

period, we can calibrate parameters (θ, ϕ, and α) from above equations for both the periods.

3.4 Results

Competitive pressure would reflect potential of the economy and productivities of skilled and unskilled labour. We evaluate the wage inequality between skilled and unskilled labour for a period by setting a comparison with their productivity inequality. Skilled and unskilled wages in the perfectly competitive environment would reflect their respective productivities. Optimum supply of education in the first period leads to higher demand for it. In the second period there will be an increase in supply of skilled labour. Optimum investment plays important role in the capital formation for the second period stimulating demand for economic activity in the first period and supply in the second period. We implement a decomposition methodology that segregates the individual effects of different variables responsible for the change in wage ratio from the observed to competitive. Similarly, efficiency of the economy, i.e. ratio of observed output to the potential is also decomposed. Elasticity parameters are crucial for determinants of wage differentials by influencing the factor demand. We consider two scenarios with low and high elasticity of substitutions between skilled and unskilled labour.

The analysis shows that Indian economy is operating at the 88 and 49 percents of its potential for the periods 1994 and 2002 respectively in case of a lower elasticity of substitution between two types of labour (See Table 3.2). Similarly, in case of a higher elasticity of substitution, the economy operates at its 90 and 47 percents in 1994 and 2002 respectively. Introduction of perfectly competitive market would remove almost 50 percent of the inefficiencies of the economy in the long run by doubling the economic activities.

Table 3.2: Efficiency, competitive and observed wages for 1994 and 2002

	Elasticity of substitutions between skilled and unskilled: 0.5		Elasticity of substitutions between skilled and unskilled: 2.5	
	1994	**2004**	**1994**	**2002**
Efficiency	0.88	0.49	0.90	0.47
Competitive wage ratio (productivity ratio)	6.93	1.76*	3.50	2.19*
Competitive wage ratio / observed wage ratio	2.35	0.60	1.19	0.75
Competitive skilled wage / observed skilled wage	2.42	0.79	2.12	0.84
Competitive unskilled wage / observed unskilled wage	1.03	1.30	1.79	1.12

* Returns to education, $\{ (P_s^1 / w_u^1) = (w_s^1 / w_u^1) - 1 \}$, are 0.76 and 1.19 respectively for the low and high elasticity of substitutions respectively. Considering 8 periods of gap, the annualised returns turn out to be around 7.3 % and 10 % respectively.

As the competitive skill premium accounts for the cost of education including the wage forgone, we define the returns to education as the ratio of competitive skill premium to competitive unskilled wage. The annualised returns to education between 1994 and 2002 are found to be 7.3 and 10 percents for the lower and the higher elasticity of substitutions respectively[22]. We report wage inequality as ratio between skilled and unskilled wages (relative wage). Table 3.2 shows that the productivity ratios between skilled and unskilled labour are much higher in the initial period than the second, implying higher productivity inequality in 1994 than in 2002. With a lower elasticity of substitution, relative productivity remains as high as 6.93 in 1994 and drops significantly to 1.76 in 2002. However, the relative productivity declines significantly in 1994 with the increase in the elasticity of substitution. A higher elasticity of substitution reduces the difference between the relative productivities in 1994 and 2002. It s noticed that productivity inequality remains significantly above the wage inequality in the initial period and below

[22] Asian Development Bank (2007) reported returns to education for 2004 based on Mincerian equation, which are 6.3 and 12.3 (middle level education) for mid-carrier and senior workers respectively.

in the second period. Analysis of skilled and unskilled wages with respect to their competitive rewards would explicate the patterns of relative wage inequalities with respect to their relative productivities.

We see from the Table 3.2 that productivity of the skilled labour is more than double of the observed wage in 1994 and less than the observed wage in 2002, implying that skill labour is considerably underpaid than its productivity in the initial period and over paid in the second period. On the other hand, productivity of unskilled labour is higher than the unskilled wage in both the periods. Increase in economic activities, e.g. service sectors, under a competitive environment incites higher demand for skilled labour, which pushes the productivity of skilled labour higher than the base wage in the initial period. Due to a lower elasticity of substitution between skilled and unskilled labour, unskilled productivity rises only marginally higher than the unskilled wage in the initial period; a higher substitutability between types of labour increases the scope of productive potential of unskilled labour. There is an increase in supply of skill labour in the second period along with a significant rise in economic activities that lets the productivity of skilled labour fall below the skilled wage and unskilled productivity rise above the unskilled wage.

Giving a cursory look at the sector-wise activities in Table 3.3, we see a significant rise in the output of 'other services' and 'education' under a competitive environment compared to the observed, while 'agriculture', 'light manufacturing', 'heavy manufacturing' (particularly in the first period) and 'transport and storage' sectors have shown a poor performance. The second period is marked by a remarkable growth in the service sectors, in general, and the 'other services', in particular, which has been largely responsible to push the economy to its frontier by doubling the final demand in the long run. It is worth mentioning here that information technology services and outsourcing have been major contributors to the performance of the 'other services' these days. It is expected that competitive environment and opening of the economy

would enhance the performance of these sectors. The significant rise in exports of these services would help finance the imports of other final goods.

Table 3.3: Sector-wise ratio of optimal to observed output

	Elasticity of substitution between skilled and unskilled: 0.5		Elasticity of substitution between skilled and unskilled: 2.5	
	1994	2002	1994	2002
Agriculture and allied	0.45	0.14	0.37	0.17
Mining and quarrying	1.11	1.02	1.06	1.02
Light manufacturing	0.15	0.75	0.13	0.89
Heavy manufacturing	0.38	0.99	0.37	1.14
Construction	1.63	1.12	1.99	1.13
Electricity, gas and water	0.71	1.47	0.71	1.57
Transports, storage	0.71	0.54	0.74	0.61
Wholesale, ret. trade	1.00	1.76	1.02	1.95
Finance, insurance, real est.	1.02	1.40	1.06	1.49
Education	2.58	2.03	2.60	2.14
Other services	3.96	7.00	4.29	7.06

In our study, trade efficiency, human capital formation (education process), physical capital formation (includes optimum investment), and static allocative efficiency are four major intertwined factors contributing to the performance of the economy and to the relative change in productivity inequality over the wage inequality. Segregation of the aggregates (efficiency and ratio of relative productivity to relative wage) into these four sources of effects reflects the significance of each of the factors. We undertake the decomposition exercise for both initial and final periods. If value of the change of aggregate factor is more than one, the positive effect of individual factor would be more than or equal to one. In this case, if the value of individual effect were less than one, it would explain the depressing effect on the aggregate. Efficiency of an economy is always less than or equal to one. If the economy were fully efficient, efficiency of the economy would be one. Ratio of relative productivity to relative wage could be either less or more than one.

Efficiencies of the economy, around 90 and 50 percents for the years 1994 and 2004 respectively suggest that the performances of the economy are

around 10 and 50 percents below its potential in these periods. Table 3.4 shows that the major reason for the inefficiency of the economy is lack of efficiency from free trade, followed by poor physical capital formation. Human capital formation has been a crucial factor for the low efficiency of the economy in the second period. In case of low elasticity of substitution between skilled and unskilled labour, the static allocative efficiency (1.07 and 1.04 for 1994 and 2002 respectively) contributes the most in inspiring the performance of the economy. It adds about 7 percent and 4 percent to the efficiencies on an average in 1994 and 2004 respectively, while the trade efficiency (0.83 and 0.61 for 1994 and 2002) has lowering impacts of about 17 and 39 percents for the initial and the second periods. Human capital formation also, only in the initial period, plays an important role in the efficiency of the economy. After a decade of the reform process, in 2004, the economy operates almost 50 percent of its potential[23]. Importance of trade efficiency has almost doubled over this period. Contribution of human capital formation to the efficiency which is 1.03 in 1994 drops to 0.84 in 2002, indicating that optimum education adds around 3 percent on an average to the efficiency in the initial period, while an increased supply of skilled labour due to education process reduces the efficiency by around 16 percent in the second period. The pattern is almost the same in case of a higher elasticity of substitution as well. Inspiring an efficient international trade condition and an investment process could remove the existing inefficiencies of the economy.

[23] This could be due to our inter-temporal nature of preference, where optimal investment process in the initial period lead to squeeze in final demand by increasing the savings for propping up the capital formation in the second period.

Table 3.4: Multiplicative decomposition of efficiency and productivity-wage ratios

	Efficiency		Relative productivity/ relative wage		Productivity of skilled labour/ skilled wage		Productivity of unskilled labour/ unskilled wages	
	1994	2002	1994	2002	1994	2002	1994	2002
Elasticity of Substitution between Skilled and Unskilled: 0.5								
Trade efficiency	0.83	0.61	4.91	2.01	3.11	1.65	0.63	0.82
Human capital	1.03	0.84	0.88	0.32	1.03	0.67	1.17	2.13
Physical capital	0.97	0.93	0.94	1.04	0.98	0.9	1.04	0.87
Static allocative efficiency	1.07	1.04	0.58	0.92	0.77	0.79	1.34	0.86
Total	**0.89**	**0.49**	**2.35**	**0.6**	**2.42**	**0.79**	**1.03**	**1.30**
Elasticity of Substitution between Skilled and Unskilled: 2.5								
Trade efficiency	0.82	0.57	1.6	1.03	2.58	1.61	1.27	1.23
Human capital	1.03	0.85	0.95	0.74	1.02	0.74	1.15	1.25
Physical capital	1.00	0.90	0.99	0.93	0.99	0.9	1.11	0.98
Static allocative efficiency	1.07	1.07	0.79	1.07	0.81	0.79	1.1	0.75
Total	**0.90**	**0.47**	**1.19**	**0.75**	**2.12**	**0.84**	**1.79**	**1.12**

Trade efficiency is the sole factor responsible for higher productivity inequality compared to the wage inequality, while the static inefficiency has the most dampening effect on it (see Table 3.4). The ratio of relative productivity to the relative wage declines in the second period and it is mainly due to descending impact of human capital formation (education process). Stimulating effect of the free trade is not enough to compensate the lowering impact of the human capital formation. Analysing independently the skilled and the unskilled wages, it is noticed that trade efficiency has also significant contribution to the higher productivity of skilled labour vis-à-vis its wage irrespective of time period and degree of elasticity of substitutions. The static efficiency factor in the economy has a significant dampening effect on the increase in ratio of skilled productivity to the wage. Not surprisingly, skill formation (human capital formation)) has considerable reducing effect on the ratio of productivity of skilled labour to its wage in the second period. It can be seen that inducing effect of the trade efficiency is not enough to outweigh the dampening effects of static allocative efficiencies, skill and capital

formations on productivity-wage ratio of the skilled labour in the second period.

As opposed to the case of competitive skilled wage, unskilled wage seems to be sensitive to the degree of elasticity of substitutions between skilled and unskilled labour. We notice from Table 3.4 that with a lower degree of elasticity of substitution, the weak effect of trade efficiency is solely responsible for the marginally higher productivity of unskilled labour relative to the unskilled wage. Static efficiency contributes the maximum in raising the competitive unskilled wage in the first period, followed by human capital formation. Endogenous investment helps increase in productivity of unskilled labour with respect to the wage, only in marginal. As the trade efficiency (gain from the international integration) is oriented more towards the skilled activities in the initial period, the allocative efficiency spurs the demand for unskilled labour. There is an increase in the ratio of productivity of unskilled labour to its wage in the second period compared to the initial period in case of lower elasticity of substitution. This increase is not due static efficiency as in the case of initial period, but mainly because of relatively higher supply of skilled labour through human capital formation. On the other hand, with the higher elasticity of substitution, trade efficiency is largely responsible for higher productivity of unskilled labour relative to its wage. If the technology allows greater degree of substitutability between two types of labour, increased activities of the competitive economy due to free trade would enhance the demand for both types of labour. Competitive pressure with higher degree of elasticity of substitution results in significantly higher unskilled wage in the short run. Besides the trade efficiency, all other factors have almost equal contribution to the ratio of productivity of unskilled labour relative to the wage in the initial period. The productivity-wage ratio of unskilled labour is much less in the second period compared to the initial period. This is because, encouraging impacts from free trade and human capital formation in the long run are not high enough to sufficiently over-compensate the lower effects from capital formation and efficiencies.

3.5 Conclusion

The study has used a dynamic frontier-general equilibrium approach to evaluate the efficiency of the Indian economy, and the relative wages of the skilled and unskilled labour compared to their relative productivities. Skilled and unskilled wages in a perfectly competitive environment reflect their productivities. Time periods under consideration are 1994 and 2002. We decompose the efficiency of the economy and the ratio of relative productivity to the relative observed wage to capture the importance of various factors. The data shows that the observed wage inequalities (skilled-unskilled wage ratio) for two periods are 2.95 and 2.91. However, productivity inequalities (skilled-unskilled competitive wage ratio) are 6.93 and 1.76 in 1994 and 2002 respectively for the lower elasticity of substitution between skilled and unskilled labour, and 3.50 and 2.19 for the higher elasticity of substitution. Relative productivity of skilled and unskilled labour is significantly higher than the relative wage in the initial period and less than the relative wage in the second period. A lower elasticity of substitution between two types of labour in the initial period results in a significant increase in the skilled productivity compared to the observed skilled wage and only marginally for the unskilled labour. However, in the second period, there is an increase in supply of skilled labour due to the better performance of the education sector leading to a decline in the productivity of skilled labour even lower than the observed skilled wage. The decline in skilled productivity relative to its observed wage, along with the rise in productivity of unskilled labour relative to its observed wage in the second period leads to a decline in the productivity inequality relative to the wage inequality in the second period. On the other hand with a higher elasticity of substitution between skilled and unskilled labour, competitive pressure lowers the ratio of level of relative productivity to the relative observed wage in the initial period. This is because higher elasticity of substitution in the initial period does not allow large increase in the

productivity of skilled labour relative to the productivity of unskilled labour. However, the optimum returns to education remains higher with a higher elasticity of substitution.

Complete openness would remove the existing inefficiencies in the economy. The economy in the initial period operates approximately at 90 percent of its efficiency, while the second period at 50 percent. Optimal investment process in 1994 leads to an increase in capital formation in 2002. In the absence of a completely competitive market, economy, in 2002, faces an under investment of resources, which is responsible for the significantly lower efficiency in the economy.

In a nutshell, we conclude that

(1) Openness of the economy and education would lead to higher productivity inequality than the wage inequality between skilled and unskilled labour in the initial period (1994). However, in the second period (2002), the productivity inequality reduces and even the relative wages remain higher than the relative productivities.

(2) Relative productivity is higher in the initial period than the second period. There exists a significantly higher productivity inequality than the wage inequality in the initial period and other way around in the second period. However, the ratio of productivity inequality to the wage inequality shrinks in the initial period with the higher elasticity of substitution compared to the lower elasticity of substitution.

(3) The annualised optimum returns to education is found to be around 7 percent in case of a lower elasticity of substitution between skilled and unskilled labour and 10 percents for a lower and a higher elasticity of substitution.

(4) Efficiency from a free trade is mainly responsible for raising the productivity of skilled labour relative to the wage in the initial period irrespective of elasticity of substitutions

between skilled and unskilled labour. Though trade efficiency has also inducing effect on the productivity of skilled labour relative to the wage in the second period, the opposite effects from static allocative efficiency, human and physical formations, depress it.

(5) As opposed to the case of productivity of skilled labour, trade efficiency reduces the productivity of unskilled labour under a lower elasticity of substitution. Allocative efficiency is more responsible for resulting in a higher productivity of unskilled labour than the wage in the initial period, while human capital formation is in the second period. In case of a higher elasticity of substitution, while all the factors are responsible for inducing a higher productivity of the unskilled labour relative to the wage in the initial period, trade efficiency and human capital formation are in the second period.

(6) Indian economy performs almost at 90 and 50 percents of its potential in the periods, 1994 and 2002. Competitive pressure would remove the existing inefficiencies by spurring the economic activities. Service sector activities play significant role in a competitive environment. The economy, in both the periods, is operating bellow its optimum, mainly because of lowering impact from trade efficiency. In the second period, an increased supply of skilled labour due to the education process (human capital formation) is also responsible for the lower efficiency of the economy, as this could not be matched by enough demand for it.

3.6 Appendix I

$$(A1)\ D^t: \quad \sum_i f_i^t P_i^t = (\beta)^t \qquad t = 0,1$$

$$(A2)\ X_i^t: \quad P_i^t = \sum_j A_{ij}^t P_i^t + P_{v_i}^t \qquad \begin{cases} i = 1,\ldots,10 & t = 0 \\ i = 1,\ldots,11 & t = 1 \end{cases}$$

$$(A3)\ X_{11}^0: \quad P_{11}^0 = \sum_j A_{11,j}^0 P_{11}^0 + P_{v_{11}}^0 - \chi_e \lambda^0$$

$$(A4)\ K_i^t: \quad P_{v_i}^t \theta_i^t (1-\phi_i^t)(K_i^t)^{-\phi_i^t} [\alpha_i^t (L_{s_i}^t)^{\rho_i} + (1-\alpha_i^t)(L_{u_i}^t)^{\rho_i}]^{\frac{\phi_i^t}{\rho_i}} = r_i^t$$

$$(A5)\ L_{s_i}^t: \quad P_{v_i}^t \theta_i^t (K_i^t)^{1-\phi_i^t} \phi_i^t [\alpha_i^t (L_{s_i}^t)^{\rho_i} + (1-\alpha_i^t)(L_{u_i}^t)^{\rho_i}]^{\frac{\phi_i^t}{\rho_i}-1} \alpha_i^t (L_{s_i}^t)^{\rho_i - 1} = w_u^t + P_s^t$$

$$(A6)\ L_{u_i}^t: \quad P_{v_i}^t \theta_i^t (K_i^t)^{1-\phi_i^t} \phi_i^t [\alpha_i^t (L_{s_i}^t)^{\rho_i} + (1-\alpha_i^t)(L_{u_i}^t)^{\rho_i}]^{\frac{\phi_i^t}{\rho_i}-1} (1-\alpha_i^t)(L_{u_i}^t)^{\rho_i - 1} = w_u^t$$

$$(A7)\ \sigma^0: \quad \chi_c \xi = w_u^0 + \chi_e$$

$$(A8)\ \Delta S: \quad P_s^1 = \chi_c$$

$$(A9)\ I^0: \quad \sum_i r_i^t \delta_i = \sum_i P_i^0 \tau_i^0$$

$$(A10)\ T_g^t: \quad \pi_g^t \varepsilon^t = P_g^t \qquad g \subset i: tradables$$

3.7 Appendix II

The multiplicative decomposition is written as $\frac{V^*}{V^0} = D_T D_E D_I D_F$.

$$D_T = \left[\frac{T^* E^0 I^0 F^0}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \quad when\ S = \{1\}$$

$$\cdot\left[\frac{T^* E^* I^0 F^0}{T^0 E^* I^0 F^0}\right]^{\frac{1}{12}} \quad when\ S = \{1,2\}$$

$$\cdot\left[\frac{T^* E^0 I^* F^0}{T^0 E^0 I^* F^0}\right]^{\frac{1}{12}} \quad when\ S = \{1,3\}$$

$$\cdot\left[\frac{T^* E^0 I^0 F^*}{T^0 E^0 I^0 F^*}\right]^{\frac{1}{12}} \quad when\ S = \{1,4\}$$

$$\cdot\left[\frac{T^* E^* I^* F^0}{T^0 E^* I^* F^0}\right]^{\frac{1}{12}} \quad when\ S = \{1,2,3\}$$

$$\cdot\left[\frac{T^* E^* I^0 F^*}{T^0 E^* I^0 F^*}\right]^{\frac{1}{12}} \quad when\ S = \{1,2,4\}$$

$$\cdot\left[\frac{T^* E^0 I^* F^*}{T^0 E^0 I^* F^*}\right]^{\frac{1}{12}} \quad when\ S = \{1,3,4\}$$

$$\cdot\left[\frac{T^* E^* I^* F^*}{T^0 E^* I^* F^*}\right]^{\frac{1}{4}} \quad when\ S = \{1,2,3,4\}$$

Similarly, we can derive for D_E, D_I and D_F respectively.

$$D_E = \left[\frac{T^0 E^* I^0 F^0}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^* E^* I^0 F^0}{T^* E^0 I^0 F^0} \cdot \frac{T^0 E^* I^* F^0}{T^0 E^0 I^* F^0} \cdot \frac{T^0 E^* I^0 F^*}{T^0 E^0 I^0 F^*}\right]^{\frac{1}{12}}$$

$$\cdot \left[\frac{T^* E^* I^* F^0}{T^0 E^0 I^* F^*} \cdot \frac{T^0 E^* I^* F^*}{T^* E^0 I^0 F^*} \cdot \frac{T^* E^* I^0 F^*}{T^* E^0 I^* F^0}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^0}{T^* E^0 I^* F^*}\right]^{\frac{1}{4}}$$

$$D_I = \left[\frac{T^0E^0I^*F^0}{T^0E^0I^0F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^*E^0I^*F^0}{T^*E^0I^0F^0} \cdot \frac{T^0E^*I^*F^0}{T^0E^*I^0F^0} \cdot \frac{T^0E^0I^*F^*}{T^0E^0I^0F^*}\right]^{\frac{1}{12}}$$
$$\cdot \left[\frac{T^*E^*I^*F^0}{T^*E^*I^0F^0} \cdot \frac{T^0E^*I^*F^*}{T^*E^0I^0F^*} \cdot \frac{T^*E^*I^0F^*}{T^0E^*I^0F^*}\right]^{\frac{1}{12}} \cdot \left[\frac{T^*E^*I^*F^*}{T^*E^*I^0F^*}\right]^{\frac{1}{4}}$$

$$D_F = \left[\frac{T^0E^0I^0F^*}{T^0E^0I^0F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^*E^0I^0F^*}{T^*E^0I^0F^0} \cdot \frac{T^0E^*I^0F^*}{T^0E^*I^0F^0} \cdot \frac{T^0E^0I^*F^*}{T^0E^0I^*F^0}\right]^{\frac{1}{12}}$$
$$\cdot \left[\frac{T^*E^*I^0F^*}{T^*E^*I^0F^0} \cdot \frac{T^0E^*I^*F^*}{T^0E^*I^*F^0} \cdot \frac{T^*E^0I^*F^*}{T^*E^0I^*F^0}\right]^{\frac{1}{12}} \cdot \left[\frac{T^*E^*I^*F^*}{T^*E^*I^*F^0}\right]^{\frac{1}{4}}$$

3.8 Appendix III

Social Accounting Matrix for India: 1994

(All the figures are in Rupees 100,000)

	Agricul-ture	Mining, quarrying	Light Manufac-turing	Heavy Manufac-turing	Construc-tion	Electricity, gas, water supply	Trans-port, storage	Wholesale, retail trade	Financial, real estate
Agriculture	5285357	10	5265521	572030	448485	4813	173982	770818	0
Mining, Quarrying	3782	22909	93215	2702252	461350	971849	5622	33259	0
Light Manufacture	307299	14105	3934489	764400	292759	10863	81668	587705	51188
Heavy Manufacture	2038421	353277	1583613	13427761	3484477	216973	2567012	285330	32179
Construction	394025	8784	18368	63311	39303	133569	209430	114152	611944
Electricity, gas, water supply.	234189	117266	690261	1908135	56870	1423012	230622	350466	102663
Transport, storage.	287181	40372	699784	1974193	599713	398938	633460	1871799	207623
Wholesale, retail trade	863051	57001	1653879	2627899	784326	279609	458022	299553	110024
Financial, real estate	298998	59429	517324	1651279	334303	244535	472256	520766	501414
Education	0	0	0	922	0	0	4580	0	0
Services	69578	55624	574069	1084187	33504	36401	403235	790374	115516
Unskilled	10403306	304311	1415858	1429416	1057715	433399	1263385	1722181	41779
Skilled	2524589	203751	1036818	2970115	2921209	229524	1729774	2472450	1441261
Capital income	12948415	1309885	2344529	5957788	849079	1600102	3505515	7547870	5797849
Private									
Government	-608178	92341	772293	3928407	514208	304101	670511	287286	38403
Capital Account									
Rest of World									
Total	35050013	2639065	20600021	41062095	11877301	6287688	12409074	17654009	9051843

Social Accounting Matrix for India: 1994 (Contd.)
(All the figures are in Rupees 100,000)

	Education	Services	Value added	Private sector	Government	Investment	Rest of the World	Total
Agriculture	41575	314579		21446103	130246	441892	154602	35050013
Mining, Quarrying	0	79727		18015	964	50752	-1804631	2639065
Light Manufacture	93566	308215		11223590	156148	495021	2279005	20600021
Heavy Manufacture	39022	1705621		4155695	1106873	12474084	-2408243	41062095
Construction	14072	45315		0	698378	9526650	0	11877301
Electricity, gas, water supply.	21021	154332		821392	177459	0	0	6287688
Transport, storage.	39131	228797		4181855	653130	392103	196415	12404494
Wholesale, retail trade	36895	413002		7694715	215421	948721	1211891	17654009
Financial, real estate	0	514261		3903486	56192		-22400	9051843
Education	5104	11		1723930	1886953		0	3621500
Services	13306	302312		2643409	5170972		83082	11375569
Unskilled	85674	1458174						19615199
Skilled	2633514	4036466						22199471
Capital	588465	1458069					-1504600	42402966
Private sector			73882068		7470600	0	1946700	83299368
Government	10156	356687	818800	5559803	209587	1212295	-218900	13947800
Savings			9512187	19927375	-3985123		87079	25541518
Rest of World								0
Total	3621501	11375569	84217635	83299368	13947800	25541518	0	

Social Accounting Matrix for India: 2002
(All the figures are in Rupees 100,000)

	Agricul-ture	Mining	Light Manufac-turing	Heavy Manufactu ring	Construc-tion	Electricity, gas, water supply	Transport, storage	Wholes-ale, retail trade	Financial, real estate
Agriculture	8152405	1571	11781772	1264603	815662	49851	210669	2468978	0
Mining, Quarrying	1664	69802	341173	10767058	1581906	1397428	5328	91131	0
Light Manufacture	554650	32309	6729752	1629724	914855	51623	275229	1257255	243243
Heavy Manufacture	3690861	633618	3592270	26372110	7641184	986414	7480859	1649472	255013
Construction	236515	72996	121318	158727	182523	286812	731074	149508	998683
Electricity, gas, water supply.	203276	190087	1164215	2529780	468650	2802526	2010113	493602	244549
Transport, storage.	1108123	188252	2677894	3620176	2203981	1078903	1589499	2126423	635126
Wholesale, retail trade	1621396	87499	3766712	4766725	1884389	655281	1657142	812638	300178
Financial, real estate	461287	74697	2034036	3483342	1340130	509974	1169992	1629645	1264746
Education	0	0	0	0	0	0	8296	0	0
Services	59155	94462	1058579	1630334	624641	322065	2842112	1662470	1345816
Unskilled	20003634	1099511	2821145	2030973	1489810	1287990	3057349	4064936	186659
Skilled	8116772	865493	2708599	5754988	9517104	746410	6517845	8053107	5787786
Capital income	22206628	4277724	5504871	13033482	3138650	2961980	7851462	21762443	20395748
Private	0	0	0	0	0	0	0	0	0
Government	-1139951	158293	965401	4332796	1441787	226868	2455346	646428	204084
Capital Account									
Rest of World									
Total	65276415	7846314	45267737	81374818	33245272	13364125	37862315	46868036	31861631

Social Accounting Matrix for India: 2002 (Contd.)
(All the figures are in Rupees 100,000)

	Education	Services	Value added	Private sector	Govern-ment	Invest-ment	Rest of the World	Total
Agriculture	57428	945863		38731528	217134	-323561	902512	65276415
Mining, Quarrying	0	808815		63738	10620	2973978	-10266327	7846314
Light Manufacture	95233	1300582		26391049	401939	1736686	3653608	45267737
Heavy Manufacture	122441	7335693		9788376	2351825	14895530	-5420848	81374818
Construction	118158	338736		0	1372891	28477331	0	33245272
Electricity, gas, water supply.	7338	523601		2038292	688096	0	0	13364125
Transport, storage.	343170	1207793		17012719	1217329	959129	1893798	37862315
Wholesale, retail trade	195515	1748419		21641915	484852	2468501	4776874	46868036
Financial, real estate	258241	1193049		18251756	394580	0	-203844	31861631
Education	51074	458		6799103	5762915	0	0	12621846
Services	332065	4090506		18847954	16154693	770707	856420	50691979
Unskilled	1333291	3551117		0			-81445	40844970
Skilled	7271673	19367539		0			-151255	74556061
Capital	2410094	6945360		0			-1083900	109404542
Private sector	0	0	199049173	0	21408701	0	7922899	228380773
Government	50702	1309871	2461200	15524244	604319	4033212	-248200	33026400
Savings			23295200	53290099	-18043494		-2550292	55991513
Rest of World				0				0
Total	12646423	50667402	224805573	228380773	33026400	55991513	0	

Chapter 4

Relative performance of formal and informal sectors in India

4.1 Introduction

The existence of formal and informal sectors, particularly in developing countries, has led to much research on defining their differences[24]. Studies have shown that the formal sector is more productive than the informal sector because of size, capital-intensive nature of production, self-selection by more productive employers for the formal activities, taxation and productive public distribution to the formal sector (Esfahani and Salehi-Isfahani, 1989; Loayza, 1996; Webser and Fidler, 1996; Schaefer, 2002; Rogers and Swinnerton, 2004; Kenyon and Kapaz, 2005). Our study attempts to look into the relative performance of formal and informal activities in India, which produce the same commodity with different technologies, by way of evaluating their productivity levels [25]. We measure total productivity and account for intermediate inputs. As ten Raa and Shestalova (2006) contend that main conceptual difference among alternative measures of total factor productivity turns out to be prices, we measure it with competitive prices instead of observed prices. Observed prices are generally not efficient as they are marked by inefficiencies and distortions of several kinds. Competitive prices are the resultant of the removal of distortions with efficient utilization and allocation of resources when the economy is pushed to its production frontier. The observed prices in the productivity accounting framework are replaced by

[24] Morrisson (1995), and Marceau and Savard (1997) described the differences in terms of scale, legal obligations and wage dualism.

[25] Instead of applying the total factor productivity growth, which is useful for inter-temporal comparison, we use relative productivity level more suitable for the comparison of formal and informal industries.

the shadow prices derived from a general equilibrium approach that incorporates intersectoral linkages. These shadow prices reflect the potential factor productivities under perfect competition. We focus on the productivity of existing technologies and do not address technological change induced by free trade. Besides finding the productivity differential between the formal and informal activities, this approach yields the potential productivity gain to the aggregate economy, if the resources were reallocated to the most productive activities.

The formal-informal division in the developing countries is an important manifestation of the co-existence of traditional technologies and family enterprises, on the one hand, and modern technology on the other (Stifel and Thorbecke, 2003). Like most of the sub-Saharan Africa and Latin American countries, the informal sectors in India contribute more than 60 percent of GDP and employ 87 percent of the labour force (Sinha et al, 2003; Gibson et al, 1986; Meagher, 1995; Schneider et al, 2000). Does this mammoth share of the informal sector contribute significantly to the health of the economy? The formal sector is generally thought to be more productive due to a better market, services accessibility and capital-intensive production (Webster and Fidler, 1996). It is often argued that the existence of the informal sector hinders the potential growth in productivity of the formal sector. In India, like some other developing countries, this debate has gathered currency at the outset of the new economic liberalization policy since the beginning of the 90s. Farell (2004) contended that informal software companies in India reduce the overall industry's productivity and profitability by 90 percent and that Indian informal apparel-makers gain a 25 percent cost advantage over their law-abiding formal counterpart.

The informal sector is defined as the unregistered sector with self-employed micro-enterprises and family owned activities. The informal sector is marked by less or no tax payment, less capital endowment, lower technology, less capital, lower wages and producing wage-goods compared to that of formal sector. The formal sector could feature mark-up pricing due to

the existence of unionisation, concentration in industries, and under-utilization of capital (Gibson and Van Seventer, 1995; Schaefer, 2002). Current measurement of the productivity differential between the formal and the informal activities requires removal of these mark-ups. The goods produced by formal and informal sectors can significantly compete with each other, as in Latin America, or they can be completely complimentary to each other, as in Africa (Kelley, 1994; Schaefer, 2002). We assume perfectly substitutable formal and informal commodities produced with different technologies. An efficient allocation of resources in a competitive environment would lead either to complete submission of production of some goods and services to one activity (formal or informal), or to sharing by equally productive activities. We evaluate the observed formal and informal activities at their potential competitive prices.

We draw our basic model from ten Raa and Mohnen (2001, 2002), which synthesizes Solow's growth accounting and the frontier data envelope analysis (DEA) in an augmented input-output optimisation model to measure aggregate productivity of the economy at shadow prices[26]. We maximize aggregate real consumption demand of the households with given commodity and factor constraints for both the formal and the informal activities. With the assumption of no technical change, the productivity level is solely due to utilization of inputs. Our index of productivity level is defined as ratio of value-added to total factor input cost all evaluated at shadow prices. Value-added is the sales value of produced output net of purchased materials, i.e. intermediate use. The value added concept is closely comparable to the amount of factors of production required, i.e. gross factor cost. Gross value added can be rationalized as a measure of output by imposing certain conditions on the production function. Bruno (1978) and Diewert (1978) had shown that if producers behave in a profit-maximizing manner, then the

[26] DEA measures sectoral efficiency by using distance functions with respect to the production possibility frontier (Fare et al., 1985 and 1994).

replacement of gross output by deflated value-added can be justified under conditions that inputs are used in fixed proportions to gross output, or the original gross-output production is functionally separable into the intermediate and all primary inputs, or if the prices of outputs and intermediate inputs vary in strict proportion. Given the Leontief type of production function in our analysis with respect to intermediate and factor inputs, the pattern of our productivity indices across the activities and between the sectors based on either gross value- added or gross output would be unbiased (see Theorem 2 from Diewert, 1978). The productivity index requires aggregation among inputs and within outputs with their relative importance or weights. Shadow prices generated by the competitive equilibrium explain the relative contribution of each factor input to the unit production at the frontier. Value added of an efficient-productive sector should account for its entire factor cost. The productivity index takes a value between zero and one. The inefficient industries, which do not match their productivity their high factor cost over the output prices, will have a productivity index less than one.

The rest of the paper is organized as follows. The next section gives an overview of the Indian formal and informal industries. Data and the structure of Indian economy with respect to formal informal sectors are discussed in Section 3. Section 4 sets up the basic model, while the fifth section presents the empirical results. The last section concludes the paper.

4.2 The formal and informal sectors in India

Before making a quantitative analysis of productivity difference between formal and informal sectors, we take a cursory look at the performance and prospects of Indian formal and informal industries in recent years. In our study there are nine commodities and services in the economy. ‘Agro processing’, ‘readymade garments’, ‘rice milling’, ‘other manufacturing’ and ‘other services’ are produced by both the formal and the informal sectors.

Besides these, ‘agriculture’ and ‘construction’ are all informal, and ‘capital goods’ and ‘government administration’ are all formal. The informal ‘rice milling’ industry, a separate unit from ‘agro processing’ is part of the rural economy. Once the domestic and international competition in was allowed for agriculture products (including rice) this industry started to grow in size with total investment of US$ 1.5 billion by the end 2002, of which $ 253.5 million was foreign investment. This induced the growth of the formal sector in the milling industry. ‘Agro processing’, which has been in the nascent stage in 1990s, has been a key focus area for its value addition to agricultural produce. This industry consists of many fragmented units, viz. diary sector, food, fish and meat processing sectors, etc, for which the share of the formal and informal sectors vary. The industry structure and ongoing transformation offer opportunities for organized players of the ‘agro processing’ (including ‘rice milling’) to grow (IBEF, 2006). Ready-made garment constitutes around 40 percent of the Indian textile industry, consisting of both large and small production retailing units. A study by Hashim (2005) shows that the textile industry is marred by inefficiency, contributing to the unit cost growth, and large-scale production (particularly in readymade garment sector) should be encouraged to make it more cost effective.

Subscribing to the terminology used by Gereffi (1994), the above-mentioned three activities (‘rice milling’, ‘agro-processing’ and ‘readymade garments’) could be treated as part of buyer-driven chains, where retailers govern the production. Traditionally, an overwhelming proportion of the retail market is occupied by the unorganised sector. But in order to cope with the intensifying competition and growing demand, the organized retail market is estimated to grow by 20 percent a year from the year 2000 (A.T. Kearney, 2006). Generally, ‘other services’ could comprise of small informal transport sectors, informal trade, and restaurants, self-employed software units, and other miscellaneous services. At the same time the big enterprises like large transport and trading companies, hotels, banking and big software industries are also part of the ‘other services’. This sector has marked a significant

growth in 1990s. Business services, communication, community services (education and health), hotels and restaurants have been fast rising growth sub-sectors [27](Gordon and Gupta, 2003). These authors argued that that significant productivity gain in the service sector has been due to high-income elasticity of demand, increased use of input of services by other industries and economic reforms.

4.3 Database and structure of the economy

The basic data are based on the formal-informal social accounting matrix for 1999-00 (Sinha, et al., 2004), with some modification (See Appendix I). There are five commodities and services produced by both the formal and the informal sectors. Besides these, 'agriculture' and 'construction' are all informal, and 'capital goods' and 'government administration' are all formal. The informal sector activities use 'casual labour' and 'informal capital' (owned by self employed), while the formal activities use both casual and regular labour, 'informal capital' and 'formal capital' (owned by entrepreneurs)[28]. Casual labour as opposed to the regular labour works on a short-term basis and can be easily displaced. Regular labour could be either relatively more efficient or at a more advantageous step of the job ladder. Part of the commodities is used as intermediate demand by both the formal and the informal sectors and the rest is absorbed by final demand. We assume intermediate consumption has the same pattern in the informal and formal sectors. There are eight categories of household groups, viz. casual labour, regular labour, self-employed and entrepreneurs, all rural or urban; these

[27] Average growth rate of service sector value added has been 7.5 percent per annum while the average aggregate GDP growth has been 5.8 per cent.

[28] Capital is defined on the basis of its ownership, viz. self-employed or employer (entrepreneur). 'Formal capital' is solely used by formal sector. Only the informal 'construction' activity requires 'formal capital' for its production. 'Informal capital' in formal sector is owned by self-employed, who is also an employer with hiring less than 6 workers.

coefficients are defined on the basis of ownership of factor endowments. Profit generated from each activity is distributed among the 'self-employed' and 'entrepreneur' households. Profit comes more form the formal activities than the informal.

The distribution of households' factor endowments is obtained from the SAM. Table 4.1 shows that casual labour is concentrated in the rural area, while regular labour is equally share by the rural and the urban households. Most of the capital, both formal and informal, is held by urban households.

Table 4.1: Factor distribution across the household groups

Household groups	Casual Labour	Regular Labour	Informal Capital	Formal Capital	Profit
Rural – Casual Labour	0.63				
Rural - Regular Wage Earner		0.50			
Rural – Self-employed			0.26		
Rural – Entrepreneur				0.03	0.03
Urban - Casual Labour	0.37				
Urban - Regular Wage Earner		0.50			
Urban – Self-employed			0.74		0.24
Urban – Entrepreneur				0.97	0.73
Total	100	100	100	100	100

Source: Authors' calculation based on Sinha, et al. (2004)

Table 4.2 shows that casual labour is mostly used by the informal sector ('agriculture', 44%; 'construction', 15%; 'other services', 17%), while regular labour is largely used by the formal sector 'other services' and 'government services'. Though there is not a big gap between the share of informal capital in the formal and informal activities, this factor is concentrated in few sub-sectors, namely 'agriculture' (26%), informal 'other services' (21%), formal 'other services' (30%). The formal 'other services' takes the major chunk of the formal capital (62%), followed by the 'other manufacturing' (22%). The formal sector generates more profit for the entrepreneurs. Production of the 'other manufacturing goods' is the most profitable activities in both formal and informal sectors, followed by the

'capital goods' in the formal sector. Finally, for our experiment, we assume 7 percent of unemployment rate (Government of India, 2000) and a 70 percent capital utilization rate for the Indian economy.

Table 4.2: Distribution of factors and output across formal and informal activities

Sectors	Causal Labour	Regular Labour	Informal Capital	Formal Capital	Profit	Output
Informal						
Agriculture	44.04		26.14		2.00	15.73
Agro Processing	0.86		1.11		0.36	1.79
Rice Milling	0.33		0.42			0.19
Readymade Garments	0.08		0.10		0.09	0.14
Other manufacturing goods	4.11		5.26		23.92	7.54
Capital Goods	0.00		0.00			0.00
Construction	14.74		2.49	6.00		6.40
Other Services	16.88		21.00			13.74
Government Services	0.00		0.00			0.00
Total	81.04		56.52	6.00	26.37	45.52
Formal						
Agriculture	0.00	0,00	0.00			0.00
Agro Processing	0.46	0,97	1.27	2.80	0.69	2.35
Rice Milling	0.26	0,00	0.29	0.60		0.14
Readymade Garments	0.08	0,23	0.26	0.70	0.27	0.43
Other manufacturing goods	3.90	6,90	9.72	22.28	50.83	16.04
Capital Goods	0.21	2,34	2.02	5.34	21.83	4.09
Construction						0.00
Other Services	4.03	33,26	29.91	62.27		21.43
Government Services	10.01	56,31	0.00	0.00		10.00
Total	18.96	100,00	43.48	94.00	73.62	54.48

Source: Authors' calculation based on Sinha, et al. (2004)

4. 4 Assumptions and the model

Since we assume the same intermediate technology for both formal and informal sectors, the technological heterogeneity comes from differences in the intensities of primary factors of production. We model informal labour (casual) and informal capital qualitatively differently than their formal counter parts. While casual labour can freely move between the formal and informal sectors, regular workers are mobile only within the formal sector; the two types of labour are complements and regular workers have the capacity to

perform tasks of casual labour (if they are left unemployed in the regular formal work), but not the vice-versa[29]. This asymmetry generates a nonnegative competitive premium for the regular labour in the formal sector over the wage of casual labour. While the 'formal capital' and the 'informal capital' are mobile across the activities and are complements to each other, only the 'formal capital' can be used as the 'informal capital' (if it is found to be in excess supply). This results in a rent premium for the 'formal capital' over the 'informal capital'.

Productivity measurement requires competitive valuations of commodity and factors, which we derive from the following general equilibrium model. Assuming Leontief preference and noting that the conditions of the second welfare theorem hold, the competitive allocation can be determined by the maximal expansion of total final household consumption subject to the commodity and factor constraints, while preserving the composition of the vectors of private consumption of the household groups.

$$Max\ De\sum_{h}^{8} fd_h$$

$$D, x^f, x^i \geq 0$$

$$x^f + x^i \geq A^f x^f + A^i x^i + \sum_{h}^{8} fd_h D + g \qquad (p)$$

$$l^f x^f \leq N^f \qquad (\omega)$$

$$\lambda^f x^f + \lambda^i x^i \leq N^i + (N^f - l^f x^f) \qquad (w)$$

$$k^f x^f + k^i x^i \leq K^f \qquad (\rho)$$

$$\kappa^f x^f + \kappa^i x^i \leq K^i + (K^f - k^i x^i - k^f x^f) \qquad (r)$$

Endogenous variables:

D: Aggregate household consumption demand in the economy

[29] Stark (1982) assumed the existence of a 'downward linkage' between the formal sector and the informal sector in order to capture the impact of formal sector job creation on the informal sector.

x^f , x^i : Column vector of formal and informal ' output

Exogenous variables:

e : A unit row vector.

d_h : A scalar of share of h^{th} household's demand in the total (consumption weights).

f : Column vector of household's share of consumption demand for a commodity.

g : Column vector of fixed final demand other than household consumption demand.

A^f, A^i : Intermediate demand coefficients matrices of the formal and informal activities.

λ^f, λ^i : Row vector of technical coefficients of casual labour in the formal and informal sectors.

l^f : Row vector of technical coefficients of regular labour in formal sector.

κ^f, κ^i : Row vector of technical coefficients of informal capital in the formal and informal sectors.

k^f, k^i : Row vector of technical coefficient of formal capital in the formal and informal sectors.

N^f, N^i : Total supply of formal (regular) and informal (casual) labour in the economy.

K^f, K^i : Stock of formal and informal capital.

The first constraint is the commodity constraint; total demand is constrained by the perfectly substitutable formal and informal commodities. The shadow price of it, *p*, reflects the uniform shadow price for both the formal and informal sectors. The two labour constraints reflect the downward mobility of the labour. The casual labour constraint sets the base wage, *w*, for

regular labour in formal sector. This constraint shows that demand for casual labour is constrained by the sum of its supply and also the unemployed regular labourers. The third one is the constraint for regular labour. The shadow price of this constraint gives the wage premium (ω) for regular labour over the casual labour. The fourth constraint is for the demand and supply of informal capital, where demand of informal capital is constrained by the sum of its supply and the surplus of formal capital. Its shadow price sets the competitive rent (r) for the informal capital. The last constraint generates the formal capital premium, ρ.

The national income and hence the household income and consumption on the frontier are evaluated at shadow prices. The equilibrating mechanism involves maintaining the propensity to consume at competitive prices with respect to the observed level for each household group with the adjustment of household consumption weights. In the equilibrium, the ratio of new propensity to consume to the observed one should be same for each household group. This is because, if the household's propensity to consume at the optimum exceeds benchmark propensity to consume more than the other household, then the general equilibrium welfare maximization requires that former household should be assigned with higher consumption share than the later. This is compatible with the welfare maximization program that shows that a competitive equilibrium can be represented through a welfare optimum with non-zero welfare weights (consumption weights) such that all consumers satisfy their budget constraints (Negishi 1960).

The optimum income of formal and informal households are written as $Y_f = r\gamma_K^i K^i + (r+\rho)\gamma_K^f K^f + w\gamma_N^i N^i + (w+\pi)\gamma_N^f N^f$ and $Y_i = r\gamma_K^i K^i + (r+\rho)\gamma_K^f K^f + w\gamma_N^i N^i$, given household groups' shares γ_K^f and γ_K^i of formal and informal capital, and γ_N^f and γ_N^i of regular and casual labour. The new propensity to consume at competitive prices is $m_h^1(d) = pfd_h D / Y_h^1$, where the subscript h stands for both formal and informal household groups (h = 1,…,8). The observed propensities to consume, $m_h^0(d)$, valued at competitive prices are similar, but

with the optimal consumption baskets $f_h d_h D$ replaced by the observed baskets. Now the equilibrating mechanism is $\frac{m_h^N(d)}{m_h^0} = \frac{m_{h+1}^N(d)}{m_{h+1}^0}$, where h = *1,…7.* The maximization program is iteratively recomputed with adjusted consumption weights resulting in final optimum values for the endogenous variables.

We thus find the optimum pattern formal and informal production along with the supporting shadow prices of commodities and factors of production. We use shadow prices to compute productivity index for each activity in the observed economy. Given below are the productivity indices based on value-added concept.

$$\Pi^f = \frac{(x_0^f - A^f x_0^f)p}{(r+\rho)k^f x_0^f + r\kappa^f x_0^f + (w+\omega)l^f x_0^f + w\lambda^f x_0^f} = \frac{(I-A^f)p}{(r+\rho)k^f + r\kappa^f + (w+\omega)l^f + w\lambda^f}$$

$$\Pi^i = \frac{(x_0^i - A^i x_0^i)p}{(r+\rho)k^i x_0^i + r\kappa^i x_0^i + w\lambda^f x_0^i} = \frac{(I-A^i)p}{(r+\rho)k^i + r\kappa^i + w\lambda^f}$$

x_0^f and x_0^i are observed formal and informal production respectively. Our dual program, where factor costs are minimized subject to price constraints, besides normalizing the prices, defines the shadow prices in the following constraints.

$$p(I-A^f) \le (r+\rho)k^f + r\kappa^f + (w+\omega)l^f + w\lambda^f$$

$$p(I-A^i) \le (r+\rho)k^i + r\kappa^i + w\lambda^f$$

This shows that value added of an activity must be less than or equal to factor costs. Equality holds for the active sectors due to complementary slackness (see ten Raa, 2005). This establishes that our productivity indices take the value between 0 and 1. The inefficient production activity is marked by the index less than 1. If we use gross output instead of the value-added, the productivity indices will become

$$\Pi^f = \frac{p}{(r+\rho)k^f + r\kappa^f + (w+\omega)l^f + w\lambda^f + A^f p} \quad ,$$

$$\Pi^i = \frac{p}{(r+\rho)k^i + r\kappa^i + w\lambda^f + A^i p}$$

We can also notice from our dual program that the values of these indices also vary between 0 and 1.

The maximization of final consumption demand in the primal program gives us the expansion factor, $c = D^* / D_0$, which is considered as negative measure of efficiency, which compares the potential of the economy against the actual performance. The D^* is the value of total consumption demand at the optimum, while D_0 is the observed value. We could also see from the objective values of primal and dual that the productivity level (ratio of total final demand to the total factor cost evaluated at shadow prices) of overall economy is the inverse of the optimal expansion factor (see ten Raa, 2006).

Given the difference in technology between formal and informal activities to produce homogeneous commodities and services, the pattern of specialization at the frontier will depend on our substitutability and mobility assumption of factors of production. The gain in production efficiency is achieved through better production and allocation of resources. However, if there is an under-utilization of resources in the observed economy, the full utilization of them at the frontier results in an additional gain in efficiency[30]. The varying degree of degree of utilization rates among different factors of production affects the competitive factor prices and, hence the productivity differentials. This also additionally decides the pattern of sectoral productivity and specialization[31].

[30] This can be defined as X-efficiency (ten Raa, 2004).

[31] Besides the degree of underutilization, alternative assumptions regarding the mobility and substitutability of factor of production would generate different patterns of specialization at the frontier.

4.5 Model Results

Our productivity level, i.e. the ratio of value added to factor cost at competitive prices, ranges from 0 to 1. Productivity level unit implies that given the competitive prices, the particular technology is efficient and hence is able to recover the factor costs as value added. Productivity level less than one suggests that it is costly to produce that commodity or service by that technology (formal or informal). The formal and the informal activities could be equally efficient in producing any goods and services if both have productive level of unit ratio. Table 4.3 shows that formal activities producing all goods and services are more productive than the informal activities. Only in the production of informal 'other services' is productive as its formal counterpart to produce 'other services'. Shadow prices for the factor of production that the model generates reflect the factor productivities at the frontier. Table 3 shows that both formal and informal capitals are the economically scarcest primary inputs having highest competitive rewards and the casual labour is the least.

Table 4.3: Productivity Levels and Shadow Prices

	Productivity		Shadow Prices				
Activities	Informal	Formal	Output	Casual Labour	Regular Labour	Informal Capital	Formal Capital
Agriculture	1.00	X	0.93	1.69	5.80	11.05	11.05
Agro Processing	0.93	1.00	1.05	1.69	5.80	11.05	11.05
Readymade Garments	0.97	1.00	1.00	1.69	5.80	11.05	11.05
Rice Milling	0.96	1.00	1.05	1.69	5.80	11.05	11.05
Other manufacturing	0.97	1.00	0.75	1.69	5.80	11.05	11.05
Capital	X	1.00	0.58	1.69	5.80	11.05	11.05
Construction	1.00	X	0.63	1.69	5.80	11.05	11.05
Other Services	1.00	1.00	1.12	1.69	5.80	11.05	11.05
Government	X	1.00	0.62	1.69	5.80	11.05	11.05
Expansion Factor	1.38						

Note: X stands for the commodity not at all produced by either of the activities.

It is also observed that optimum allocation yields no competitive premium for the formal capital over the informal indicating that they are

equally productive, while the regular labour is more productive than the casual labour. We see from the Table 4.2 that almost 94 percent of formal capital, 43 percent of informal capital and all regular labour are used by formal activities. Hence, it is expected that overall formal sector would be more productive than the informal. We could also notice that the observed economy is operating at an efficiency level of 0.72, which is the inverse of the expansion factor, 1.38. This implies that there would be a potential gain in efficiency for the economy by 28 percent if factors were reallocated to productive sectors.

4.6 Conclusion

We use shadow prices instead of observed inefficient prices to evaluate productivity differences between the formal and informal activities in Indian economy. Our model synthesizes the frontier analysis with the general equilibrium approach to generate shadow prices. Our major finding is that formal sector activities are strictly more productive than the informal ones except for the 'service sector', where the formal and the informal production technologies are equally efficient. Capitals are scarcer factors than labours indicating higher competitive rents than wages. Formal capital is as productive as informal capital and formal labour is more productive than informal labour. If factors were efficiently allocated to the productive activities, there would be a potential productive gain of 28 percent for the economy. We concede that results can be refined with the help of more disaggregated classification of production sectors.

4.7 Appendix I

Social Accounting Matrix for India (Formal-Informal Sectors): 1999
(All the figures are in Rupees 100,000)

		FACTORS OF PRODUCTION						HOUSEHOLDS			
		Casual Labour	Casual Labour	Regular Labour	Marginal capital	Capital	Profit	Casual Labour	Regular Labour	Self emplo-yed	Entrepr-eneur
		I	F	F	I	F					
Casual Labour	I										
Casual Labour	F										
Regular Labour	F										
Marginal Capital	I										
Capital	F										
Profit											
Casual Labour		420531	98386	0	0	0	0				
Regular Labour		0	0	363167	0	0	0				
Self Employed		0	0	0	874153	0	30472				
Entrepreneur		0	0	0	0	57160	96905				
Government								81623	99772	54058	16103
Rest of the world											
Agriculture	I							128407	50099	144157	3601
Agro Processing	I							13956	7801	28853	1596
Rice Milling	I							1360	581	955	99
Readymade Garments	I							496	368	920	50
Other manufacturing goods	I							15918	16233	13117	1619
Capital goods	I							0	0	0	0
Construction	I							0	0	0	0
Other Services	I							109362	68104	23914	10109
Government	I							0	0	0	0
Agriculture	F							0	0	0	0
Agro Processing	F							19686	20625	24105	1783
Rice Milling	F							851	382	579	60
Readymade Garments	F							1522	1127	966	151
Other manufacturing goods	F							48782	42447	18702	4498
Capital Goods	F							0	0	0	0
Construction	F							0	0	0	0
Other Services	F							106480	82803	93295	12216
Government Services	F										
Savings										505990	118177
Total		420531	98386	363167	874153	57160	127377	528442	390342	909611	170060

Note: 'I' and 'F' stand for informal and formal sectors respectively.

Social Accounting Matrix for India (Formal-Informal Sectors): 1999 (Contd.)

(All the figures are in Rupees 100,000)

				PRODUCTION SECTORS (INFORMAL)								
		Gove-rnment	Rest of the world	Agri-culture	Agro Process-ing	Rice Milling	Ready-made Garments	Other manufact uring	Capital goods	Const-ruction	Other Services	Gove-rnment
				I	I	I	I	I	I	I	I	I
Casual Labour				228511	4487	1719	405	21306	0	76501	87602	0
Casual Labour												
Regular Labour				0	0	0	0	0	0	0	0	0
Marginal Capital				228511	9679	3708	875	45978	0	21730	183610	0
Capital				0	0	0	0	0	0	3429	0	0
Profit				2551	459	2	111	30472	0	0	0	0
Casual Labour		3559	5966									
Regular Labour			27175									
Self Employed		989	3997									
Entrepreneur		0	15995									
Government												
Rest of the world		105										
Agriculture	I		9330	57744	29548	722	81	13296	0	5974	13780	0
Agro Processing	I		3799	1002	1730	0	0	105	0	0	955	0
Rice Milling	I		286	2102	97	85	0	0	0	0	184	0
Readymade Garments	I		2211	0	0	0	0	11	0	0	18	0
Other manufacturing goods	I		-9140	6558	1340	104	806	32996	0	23450	21897	0
Capital goods	I		0	0	0	0	0	0	0	0	0	0
Construction	I		0	3160	174	31	10	886	0	1904	12166	0
Other Services	I		28823	10470	4626	130	381	20829	0	17145	39487	0
Government	I		0	0	0	0	0	0	0	0	0	0
Agriculture	F		0	0	0	0			0	0	0	0
Agro Processing	F		5268	3587	2551	0	0	138	0	0	1254	0
Rice Milling	F		179	1316	61	158	0	0	0	0	115	0
Readymade Garments	F		6812	0	0	0	19	33	0	0	56	0
Other manufacturing goods	F		-19424	13936	2847	221	1712	70116	0	49832	46531	0
Capital Goods	F		-2385	2469	785	12	94	7697	0	7811	16141	0
Construction	F		0	0	0	0	0	0	0	0	0	0
Other Services	F		46627	16938	7484	210	616	33698	0	27737	81845	0
Government Services	F	367952	0	0	0	0	0	0	0	0	0	0
Savings		-69016	-125414									
Total		303589	105	578855	65868	7102	5110	277561	0	235513	505641	0

Note: 'I' and 'F' stand for informal and formal sectors respectively.

Social Accounting Matrix for India (Formal-Informal Sectors): 1999 (Contd.)

(All the figures are in Rupees 100,000)

		PRODUCTION SECTORS (FORMAL)										
		Agri-culture	Agro Process-ing	Rice Milling	Ready-made Garm-ents	Other manufac-turing	Capital Goods	Const-ruction	Other Services	Govern-ment Services	Invest-ment demand	Total
		F	F	F	F	F	F	F	F	F		
Casual Labour												420531
Casual Labour		0	2374	1353	423	20231	1103	0	20935	51967		98386
Regular Labour		0	3523	0	825	25044	8492	0	120790	204493		363167
Marginal Capital		0	11124	2574	2296	84966	17652	0	261450	0		874153
Capital		0	1603	343	399	12737	3055	0	35594	0		57160
Profit		0	877	1	341	64751	27812	0	0	0		127377
Casual Labour												528442
Regular Labour												390342
Self Employed												909611
Entrepreneur												170060
Government											52034	303589
Rest of the world												105
Agriculture	I	0	38851	452	250	28255	46	0	22293	29081	2888	578855
Agro Processing	I	0	2276	0	0	222	0	0	1543	70	1960	65868
Rice Milling	I	0	128	52	0	0	0	0	298	15	861	7102
Readymade Garments	I	0	0	0	6	25	0	0	28	5	972	5110
Other manufacturing goods	I	0	1762	65	2482	70823	12108	0	35425	5346	24652	277561
Capital goods	I	0	0	0	0	0	0	0	0	0	0	0
Construction	I	0	229	19	31	1883	540	0	19682	8279	186519	235513
Other Services	I	0	6082	81	1174	44262	8895	0	63883	19335	28549	505641
Government	I	0	0	0	0	0	0	0	0	0	0	0
Agriculture	F	0	0	0	0	0	0	0	0	0	0	0
Agro Processing	F	0	2991	0	0	294	0	0	2029	92	2114	86517
Rice Milling	F	0	80	33	0	0	0	0	187	9	1241	5251
Readymade Garments	F	0	0	0	17	71	0	0	89	15	4828	15705
Other manufacturing goods	F	0	3744	138	5275	148996	25731	0	75277	11327	39838	590526
Capital Goods	F	0	1033	8	287	16359	30682	0	26114	6638	36762	150507
Construction	F	0	0	0	0	0	0	0	0	0	0	0
Other Services	F	0	9840	132	1899	71607	14391	0	103350	31280	46520	788967
Government Services	F	0	0	0	0	0	0	0	0	0	0	367952
Savings											377703	807440
Total		0	86517	5251	15705	590526	150507	0	788967	367952	807440	

Note: 'I' and 'F' stand for informal and formal sectors respectively.

Chapter 5
Conclusions

5.1 Summary

This dissertation with the collection of three essays has addressed to a common issue, i.e. productivity and efficiency gain to the Indian economy due to perfectly competitive environment considering the inter-linkages in the economy. However, this common issue has been extended to discuss three more challenging concerns of the economy after the liberalization: welfare distribution, education and wage disparity under economic openness, and the performances of formal and informal sectors. The analytical tool combines the frontier analysis with the general equilibrium approach. The economy is pushed to its frontier while considering the intersectoral linkages. Shadow prices from the model are the competitive prices. The thesis has given a basis to explore possibilities, for study the productivity-efficiency gain linking it to many interesting topics of a developing economy. Given the vastness of Indian economy and its heterogeneous characteristics, general equilibrium analysis has, no doubt, been appropriate to capture the inter-linkages in the economy in the productivity analysis. Chapter 2 has looked into the impact of competitive pressure on the productivity and efficiency gain, income distribution and poverty among different household groups in the Indian economy. We have noticed a gain in productivity and efficiency and reduction in poverty under competition, but the income distribution has worsened. This has established the scale effect of growth in the economy. Urban households have enjoyed significantly more reduction in poverty than the rural households. Households that are largely dependent on labour and land have gained little. In fact, the agricultural worker has even suffered from an increase in poverty.

Among the urban household groups, the relative gain for the salaried class has been low.

Chapter 3 has considered education process in the productivity-efficiency analysis to evaluate wage inequality and efficiency of the economy over the year 1994 and 2002. Wages in the perfectly competitive market define the productivities of the skilled and unskilled labour. It is observed that the annualised returns to education in 2002 has been around 7 percent in case of a lower elasticity of substitution between types of labour and 10 percent for the higher elasticity of substitution. The key observation in this essay has been that in 1994 productivity inequality has been significantly higher than the wage inequality between the skilled and the unskilled labour and just the opposite in 2002. The steep decline in the productivity inequality in the second period has been mainly because of the increased supply of the skilled labour due to the human capital formation (education process). However, with a higher elasticity of substitution, the productivity inequality narrows down in the initial period. It is seen that trade efficiency has played a major role in raising the productivity of skilled labour over its wage irrespective of time period and degree of elasticity of substitutions. However, productivity of the skilled labour has remained below the wage in the second period because of the role of human capital formation. On the other hand, trade efficiency has a depressing effect on the productivity of the unskilled labour relative to its wage in case of a lower elasticity of substitution and a positive effect in case of a higher elasticity of substitution. Static allocative efficiency has contributed the most in raising the productivity of unskilled labour above its wage in the initial period and the human capital formation in the second period.

It is noticed that the economy operates almost at 90 percent of its efficiency in 1994, while only around at 50 percent in 2004. Perfect competition would remove existing inefficiencies in the economy to extent of 10 and 50 percents in 1994 and 2002 respectively. It is shown that trade efficiency should be given more importance as an engine to push the economy to perform at its potential. Service sectors would contribute the most to the

performance of the economy at its potential. Higher physical and human capital formations in the second period require more demand and utilization of resources. It is not only the lack of trade efficiency, human and physical capital formations are also responsible for the lower efficiency of the economy in the second period.

Chapter 4 has deviated from the first two chapters towards the discussion of relative performance of formal and informal sectors in terms of their productivity differentials. We have evaluated the productivity levels of the formal and informal activities with the help of competitive prices rather than observed inefficient prices. The study has shown that formal activities would be more productive than the informal. However, the informal service sector would be as efficient as the formal one. There would be an overall productivity gain of 28 percent to the economy if factors were allocated to productive activities. Shadow prices of the model have reflected that the formal capital and informal capital are the scarce factors at the optimal-efficient allocation and both are equally productive. On the other hand, formal labour is more productive than its informal counterpart.

The dissertation, no doubt, leaves scope for further improvement. Like many other applied models, the analyses are greatly constrained by proper data availability, particularly for the reliable sector-wise capacity utilization rate of capital. The models in the thesis have not dealt with the provision of public goods and the government sector activities. With the availability of the social account matrix related to the formal-informal sectors for a second period, the study in the Chapter 4 could be extended to deal with the change in productivity (performance) of formal and informal sectors over two time periods during the period. A decomposition exercise (additive or multiplicative) could also be conducted to capture the relative contribution of change in technological factor, factor supply, trade and preferences.

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Samenvatting

Sinds 1991 volgt India een drastisch economisch hervormingsprogramma. Het doel van het programma is het verhogen van het globale concurrentievermogen en het verwijderen van de bestaande ondoelmatigheden in de economie. Een prestatiegerichte economische omgeving is een vereiste voor het bereiken van hogere productiviteit. De economische liberalisatie had twee belangrijke doelen. Ten eerste, efficiënt gebruik van inputs werd bevorderd door beperkingen erop te verminderen en door beperkingen op de keuze van technologie op te heffen. Ten tweede, het openen van de economie voor de krachten van de globale concurrentie leidde tot verdere toename van effectiviteit. Dit proefschrift stelt een productiviteit-effectiviteits analyse voor, die rekening houdt met de interne verhoudingen in de Indiase economie. De analyse is verder uitgebreid op onderwerpen die belangrijk zijn in het huidige India, zoals een concurrerende omgeving, inkomensverdeling, armoede, loonongelijkheid tussen hoog- en laaggeschoolden, opbrengsten van opleiding en prestatie van de formele en informele sector.

Wij proberen de bovenstaande onderwerpen in drie onafhankelijke artikelen te vangen. Ons model gebruikt zowel de *frontier analysis,* alsmede de algemeen-evenwicht benadering om schaduwprijzen te genereren. Deze laatste weerspiegelen de competitieve prijzen. Relaties tussen sectoren worden gemodelleerd met behulp van input-output tabellen. De *social accounting matrix*, die een grote rol speelt in het vaststellen van de koppelingen in de economie, vormt het primaire databestand voor ons model. De matrix combineert nationale rekeningen met input-output tabellen en inkomensverdelingsdata van huishoudens in een gegeven periode.

Het eerste paper behandelt hoe een versterkte concurrentie de inkomensverdeling en armoede van huishoudens beïnvloedt. Wij onderzoeken de groei van effectiviteit en productiviteit, veroorzaakt door toenemende concurrentie, en de verdelingeffecten in het kader van een algemeen-evenwicht input-output model. Efficiënt gebruik van beschikbare bronnen, technische vooruitgang en vrije handel zijn onze oorzaken van groei. De welvaart stijgt als gevolg van toenemende concurrentie, maar de inkomensverdeling zou schever worden. Huishoudens op het platteland zouden er op achter uitgaan ten opzichte van stedelijke huishoudens. Armoede in steden zou veel sterker dalen dan op het platteland, de armoede van de landbouwarbeider zou zelfs toenemen. De studie laat zien dat concurrentie een positief effect heeft op effectiviteit, productiviteit en armoede, maar een negatief effect op de inkomensverdeling in de Indiase economie.

Het tweede paper beoordeelt de effectiviteit van de economie en de loonongelijkheid tussen laag- en hooggeschoolden in de competitieve omgeving van de intensieve hervormingen tussen de jaren 1994 en 2002. Wij simuleren een perfect competitieve economie, waarin de competitieve lonen productiviteit weerspiegelen. Wij vergelijken arbeidsproductiviteit met de geobserveerde lonen. Een eenvoudig twee-perioden model wordt gebruikt in onze frontier-productivity analyse om voor de kennistransformatie (opleiding) in de periode te zorgen. De jaarlijkse opbrengsten van opleiding zijn geschat op ongeveer 7 en 10 procent voor respectievelijk de lage en hoge substitutie-elasticiteit tussen laag- en hooggeschoolden. De studie laat zien dat in de eerste periode de ongelijkheid in productiviteit groter is dan de loonongelijkheid en kleiner in de tweede periode. De reden hiervoor is dat de waargenomen lonen van hooggeschoolde arbeiders lager zijn dan hun productiviteit in de eerste periode en hoger in de tweede. De efficiëntie als gevolg van handel heeft de productiviteit van hooggeschoolde arbeid, in vergelijking met het loon, in beide perioden doen stijgen. De accumulatie van menselijk kapitaal in de tweede periode is een cruciale factor in

het verlagen van de productiviteit van geschoolde arbeid ten opzichte van het loon. In beide perioden blijft het efficiëntieniveau van de economie lager dan het potentiële niveau; het is veel lager in de tweede periode. Het gebrek aan handels efficiëntie is een cruciale factor in de verklaring voor de lagere efficiëntie van de economie. Echter, de accumulatie van het menselijke en fysieke kapitaal, welke niet gevolgd wordt door voldoende vraag in de tweede periode is tevens een belangrijke factor in het verklaren van de afnemende efficiëntie. De concurrentie zal de bestaande inefficiënties in de economie verwijderen.

Het laatste essay evalueert de prestaties van de formele sector in vergelijking met die van de informele sector in India. Dit wordt gedaan door het verschil in productiviteit te bestuderen. Bij het berekenen van de competitieve algemeen-evenwicht prijzen wordt expliciet rekening gehouden met de onderlinge verhoudingen van sectoren. Deze prijzen zijn een indicatie van de productiviteit. De formele activiteiten blijken productiever dan de informele. De informele dienstensector is echter even efficiënt als de formele. Indien de productiefactoren efficiënt worden toegewezen aan productieactiviteiten, dan zou de economie een algemene productiviteitstijging kennen van 28 procent. De schaduwprijzen van het model geven aan dat het formele en informele kapitaal schaars zijn, terwijl het omgekeerde geldt voor formele en informele arbeid. Formele arbeid is productiever dan informele; formeel kapitaal en informeel kapitaal zijn beiden even productief.

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